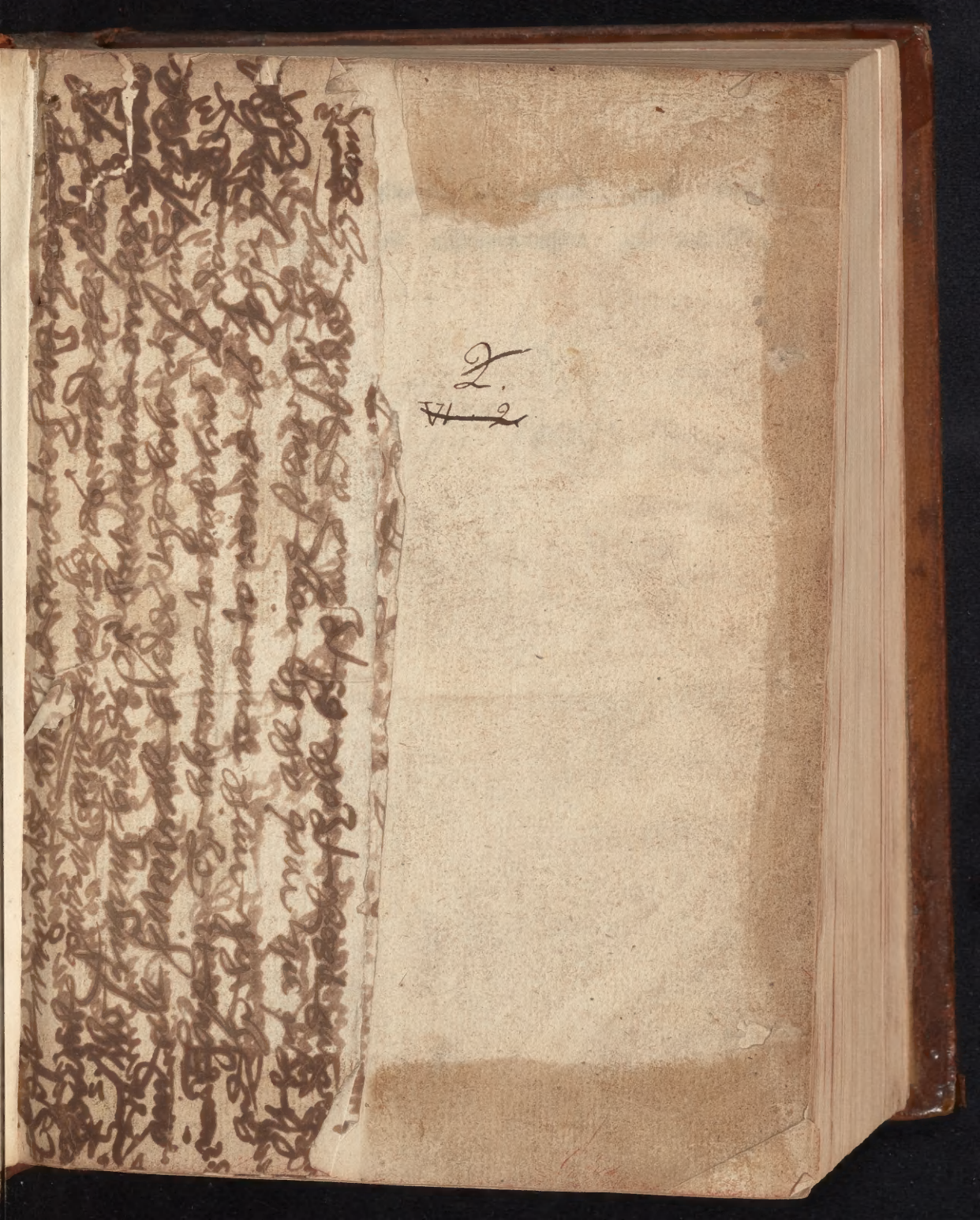
Kenelm Digby b. 11 June 1603, d. June 11. 1665

2 Treatises -

I. Nature of Bodies 1. 429.
1st ed Paris 1644. (English) July
London 1645.
1658

II Nature of Man Sect. 1. - 143
1st ed. Paris 1644
London 1645
" 1658
1669.

answered by Alexander Ross. 1645. in "The Philosophical Touchstone" and later by a Banaman, Thomson Eggenfield. in "Triumphans Anima."



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2.
~~VI. 2~~

Charles Dungomb
his book

KENELMVS DIGBY
EQVES AVRATVS

# TWO TREATISES:

In the one of which,

## THE NATVRE OF BODIES;

In the other,

## THE NATURE OF MANS SOULE, IS LOOKED INTO:

IN WAY OF DISCOVERY

OF THE

# IMMORTALITY

OF

## REASONABLE SOULES.

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Ψυχῆς φύσιν ἀξίως λόγου
Κατανοῆσαι οἴει δυνατὸν εἶναι,
Ἀνεὺ τῆς τοῦ ὅλου φύσεως;

KENELEN Digby

*Animæ naturam, absque totius naturæ,*
*Sufficienter cognosci posse, existimas?*

Plato in Phœdr.

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LONDON,
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# TO MY SONNE, KENELME DIGBY.

SONNE,

THe calamity of this time being ſuch, as hath bereft me of the ordinary means of expreſsing my affection to you; I have been caſting about, to finde ſome other way of doing that in ſuch ſort, as you may receive moſt profit by it. Therein I ſoone pitched upon theſe conſiderations; That Parents owe unto their children, not onely materiall ſubſiſtence for their Body, but much more, ſpirituall contributions to their better part, their Mind. I am much bound to God, that he hath endued you with one, very capable of the beſt inſtructions: and withall, I doe therefore eſteeme my ſelfe obliged, to doe my utmoſt for moulding

it to its moſt advantage. If my ayme therein doe prove ſucceſſefull, you will with more eaſe digeſt thoſe inconveniences & diſtreſſes, which already you have begun to be acquainted with, and that threaten daily worſe unto you. For how can a man ſuffer his heart to be dejected at the privation of any temporall bleſsings, whiles he conſidereth the inanity of them; and that nothing is worthy his ſerious thought, but what may accompany him to his eternall habitation? What needeth he feare the deſolations of Warre, and the worſt that they can do againſt him, who have his eſtate in their power, when he may be rich with a much nobler treaſure, that none but himſelfe can rob him of? Without doubt, he that ſhall ſeriouſly reflect upon the excellency of his owne nature, and upon the admirable perfect and happy ſtate he ſhal moſt certainly arrive unto, if he but weane himſelfe from thoſe worldly impediments, that here clog his ſoules flight; cannot chooſe but look with a diſdainfull eye, upon the glittering trifles, that weak ſpirits delight themſelves withall. If he deeme it not requiſite (as of old, the famous wiſe man did) to throw away thoſe en-

encumbrances, to the end he may the more freely attend unto divine contemplations (for worldly goods, duly uſed, may be very advantagious both to ones ſelfe and to others) yet at the leaſt, he will not repine at Fortnnes recalling of what ſhe formerly had but lent him, and but permitted him the uſe of.

To the end then that you may be armed againſt the worſt that may arrive unto you, in this unhappy ſtate of affaires, in our diſtreſſed Country; I ſend you thoſe conſiderations of the nature and Immortality of humane ſoules, which of late, have been my chiefe entertainment. The progreſſe you have already made in the ſtudy of Phyloſophie, hath (I am perſwaded) enabled you to benefit your ſelfe, with what I have written upon this ſubject: on the ſerious examining of which, if you will employ but half the time, that I have done in ſpinning out my thoughts, and weaving them into the piece you ſee, I doubt not but you will thereby receive ſo much contentment, as well as profit, that you will not repent you of your paines. Beſides that, intellectuall entertainments are the pureſt, and the nobleſt, and the moſt proporti-

onate to mans nature,and prove the moſt delightfull to him, when they are duly reliſhed. You will preſently agree, that the matter I handle, is the moſt important and the moſt weighty, within the whole extent of humane nature, for a worthy perſon to employ himſelfe about. The advantage which Man hath over unreaſonable creatures, is, that what he doth,is by election ; and he is himſelfe maſter of all his actions ; whereas they are impelled by outward cauſes, unto all they doe : it is properly ſaid of them, that *aguntur magis quam agunt* : He onely is free ; and in all varieties of circumſtances, hath the power to chooſe one, and to reject another. Now, to have this election wiſely made, and becomming a man, requireth that it be ſteered by knowledge. To doe any thing well, a man muſt firſt know throughly all that concerneth the action he is about ; and chiefly the end of it. And certainly, of all his actions, the government of himſelfe, is the moſt important,and neerlieſt concerning him. The end of that government, and of all a mans aymes, is by all men agreed to be Beatitude : that is, his being completely well, and in a condition of enjoying the moſt

moſt happineſſe, that his nature is capable of. For arrivall whereunto, it is impoſsible to pitch upon the direct and ſure meanes, unleſſe it be firſt determined, whether the Beatitude we ſpeak of, doe belong to this life, or be not to be attained, till we come to the next: or rather, whether or no, there be another life beſides this, to be happy in. For if there remaineth an eternity unto us, after the ſhort revolution of time we ſo ſwiftly run over here on earth; it is cleare, that all the happines which can be imagined in this fleeting ſtate, is not valuable, in reſpect of the future; nor any thing we doe here is conſiderable, otherwiſe then as it conduceth to the making our condition then, better or worſe. Now the way to be ſure of this, is either infallible authority, or evident ſcience. They that rely on the firſt, depend of others: and they onely who know, are abſolutely complete of themſelves; and have within themſelves, the principles whereby to govern their actions, in what is of higheſt conſequence to them. It is true, every body is not of a ſtraine of wit and judgement, to be of this rank: and who are not, muſt be contented to beleeve others, and be

ſatisfyed with what is taught them. But he that will be of a ſuperior orbe, muſt make this his ſtudy. This is the adequate entertainment of a worthy perſon.

To conceive how high and excellent, this ſcience of governing a man in order to Beatitude in the next world is, we may conſider, how among all arts that concern this life, the art of a Statesman, unto whom belongeth to ſee a Common-wealth well governed, is by much the nobleſt. All other arts, are but miniſterially to him. He maketh uſe of the Soldier, of the Lawyer, of the Orator, of the Antiquary, of the Phyſitian, as beſt conduceth to the end he aymeth at, of making the Commonwealth he governeth, happy and flouriſhing. All other meaner Trades ſerve him in a yet lower degree. Yet after all, he muſt take his meaſures from the Metaphyſitian or Divine. For ſince the government of a ſociety of men, aymeth at giving them the beſt being they are capable of; and ſince Mans well-being here in this life, is but inſtrumentally good, as being the meanes for him to be well in the next life; It is evident, that the States-mans art, is but inſtrumentall to that, which

which ſheweth, how every particular man muſt governe his life, to be partaker of a happy eternity. And conſequently, if a Statesman hath not this ſcience, he muſt be ſubject to a braver man then himſelfe, whoſe province is to direct all his actions unto this end. We are told, how reverently great *Cæſar* liſtned to the diſcourſes of learned *Achoreus*, how obſervant *Alexander* was of his Maſter *Ariſtotle*, how ſecure *Nero* trode, whiles *Seneca* guided his ſteps, how humble *Conſtantine* was to Saint *Sylveſters* precepts, how *Charlemaine* governed himſelfe in his moſt important actions, by *Alcuines* advice: In a word, all the great men of Antiquity, as wel among the Romans, as among the Gretians, had their Philoſophers, and Divines in their kind, belonging to them; from whom they might derive rules of living and doing as they ought upon all occaſions, if themſelves were not Maſters in that ſuperiour and all-directing ſcience. He that ſeeth not by his owne light, muſt in this dangerous Ocean ſteere by the lanterne which another hangeth out to him. If the perſon he relyeth upon, either withholdeth the light from him, or ſheweth him a falſe one, he is preſently in the dark,

darke,and cannot faile of loſing his way.How great an authority had the Augurs and Prieſts among the rude Romans, to forbid any publike act, or to break any aſſembly upon pretence of Religious duties, when they liked not the buſineſſe that was in agitation ? The like may intereſſed Divines among Chriſtians doe, if the Miniſters of State have not ſome inſight into Divinity. He leadeth a vexatious life, that in his nobleſt actions is ſo gored with ſcruples, that he dareth not make a ſtep, without the authority of another to warrant him.

Yet I doe not conclude,that he by whom I deſign by the character of a brave man,ſhould be a profeſſed or a complete Metaphyſitian or Divine, and conſummate in every curious circumſtance that belongeth to this ſcience; it ſufficeth him to know it in bulke;and to have ſo much Divinity, as in common occurrents, to be able to governe himſelfe; and in ſpeciall ones, to underſtand what, and why his Divine perſwadeth him to any thing ; ſo that even then, though not without help,yet he governeth himſelfe,and is not blindly governed by another. He that aymeth at being a perfect

Horſe-

Horſeman, is bound to know in generall (beſides the art of riding) the nature and temper of Horſes; and to underſtand the different qualities of Bits, Saddles, and other utenſils of a Horſeman; But the utmoſt exactneſſe in theſe particulars, belongeth to Farryers, Sadlers, Smiths, and other Tradeſmen; of all which, the judicious Rider knoweth how to make due uſe, when he hath occaſion, for his principall end; which is, orderly governing his Horſe. In like manner, he whom we deſigne by a complete brave man, muſt know ſolidly the maine end of what hee is in the World for: and withall, muſt know how to ſerve himſelfe when hee pleaſeth, and that it is needfull to him, of the Divines high Contemplations, of the Metaphyſitians ſubtile Speculations, of the naturall Philoſophers minute Obſervations, of the Mathematicians nice Demonſtrations; and of whatſoever elſe of particular Profeſsions, may conduce to his end; though without making any of them his profeſſed buſineſſe.

To lay grounds for ſuch knowledge as this, is the ſcope of my enſuing Diſcourſe. My firſt ayme, was to beget it in my ſelfe: to which

which end, the digeſting my thoughts into order, and the ſetting them downe in writing, was neceſſary: for without ſuch ſtrict examination of them, as the penning them affordeth one meanes to make, they would hardly have avoyded being disjoynted and roving ones. Now that I have done that, my next ayme is that you, unto whom I wiſh as much good as unto my ſelfe, may reap as much benefit by the ſtudying it, as I have done by the compoſing it.

My end then being a private one, as (looking no further then you my ſonne, and my ſelfe) I have not endeavoured to expreſſe my conceptions either in the phraſe, or in the language of the Schooles. It will ſerve our turne, to comprehend the ſubſtance, without confining our ſelves to any ſcrupulous exactneſſe, in what concerneth onely forme. And the ſame conſideration hath made me paſſe ſlightly over many particulars, in my firſt Treatiſe of the Nature of Bodies, upon which learned and witty men might ſpin out large Volumes. For in that part, I ayme no further, then to ſhew what may be effected by corporeall agents. There, poſsibility ſerveth

my

my turne, as well as the determinate indiviſible point of truth. I am obliged to that, onely in my maine great theme; which is the ſoule. In regard of which, the numerous crooked narrow cranies, and the reſtrayned flexuous rivolets of corporeall things, are all contemptible, further then the knowledge of them ſerveth to the knowledge of the ſoule. And a gallant man, whoſe thoughts flye at the higheſt game, requireth no further inſight into them, then to ſatisfie himſelfe by what way they may be performed; and deemeth it far too meane for him, to dwel upon the ſubtileſt of their myſteries for ſcience ſake.

Beſides this liberty that the ſcope I ayme at alloweth me of paſsing very curſorily over ſundry particulars; I find now at my reading all over together, what I have written to deliver it to the Printer, that even in that which I ought to have done to comply with my owne deſigne and expectation, I am fallen very ſhort; ſo that if I had not unwarily too farre engaged my ſelfe for the preſent publiſhing it, truly I ſhould have kept it by me, till I had once againe gone over it. I find the whole piece very confuſedly done; the

the ſtile unequall and unpoliſhed ; many particulars (when they are not abſolutely neceſſary to my maine drift) too ſlightly touched, and far from being driven home : and in a word,all of it ſeemeth to be rather but a looſe modell and roughcaſt of what I deſign to do, then a complete work throughly finiſhed.

But ſince by my overforward promiſing of this piece to ſeverall friends, that have been very earneſt for it,I have now brought my ſelf to that paſſe, that it would ill become me to delay any longer the publiſhing of ſomething upon this ſubject and that obligations of another nature permit me not at the preſent to dwell any longer upon this (beſides that, ſo lazie a braine as mine is,groweth ſoon weary when it hath ſo entangled a skeane as this is to unwind)I now ſend it you as it is;but with a promiſe, that at my firſt leiſure, I will take a ſtrict ſurvey of it ; and then in another Edition, will poliſh, correct and adde what ſhall appeare needfull to me. If any man ſhall take the Book out of your hand,invited by the Title and ſubject to look into it;I pray you in my behalfe repreſent unto him , how diſtant my profeſsion is,and how contrary my education hath

hath been from writing of Books. In every Art, the plaineſt that is, there is an Apprentiſhip neceſſary, before it can be expected one ſhould work in it a faſhionable piece. The firſt attempts are alwayes very imperfect aymings; and are ſcarce diſcernable what they are meaned for, unleſſe the Maſter guide his Scholars hand. Much more will the ſame happen in ſo difficult and ſpiny an affaire, as the writing upon ſuch a nice and copious ſubject as this is, to one who is ſo wholly ignorant of the lawes of Method as I am.

This free and ingenuous acknowledgment on my ſide, will I hope prevaile with all ingenuous perſons, who ſhall read what I have written, to adverti ſe me fairely (if they judge it worth their while) of what they diſlike in it: to the end that in another more accurate Edition, I may give them better ſatisfaction. For beſides what faylings may be in the matter, I cannot doubt but that even in the expreſſions of it, there muſt often be great obſcurity and ſhortneſſe; which I, who have my thoughts filled with the things themſelves, am not aware of. So that, what peradventure may ſeeme very full to me, becauſe every imperfect

touch

touch bringeth into my mind the entire notion and whole chain of circumſtances belonging to that thing I have ſo often beaten upon; may appeare very crude and maymed to a ſtranger, that cannot gueſſe what I would be at, otherwiſe then as my direct words do lead him.

One thing more I ſhall wiſh you to deſire of them who happily may peruſe theſe two Treatiſes; as well for their owne ſakes, as for mine. And that is, that they wil not paſſe their cenſure upon any particular piece, or broken parcell of eyther of them, taken by it ſelfe. Let them draw the entire thred through their fingers, and let them examine the conſequentneſſe of the whole body of the doctrine I deliver; and let them compare it by a like ſurvey with what is ordinarily taught in the Schools: and if they find in theirs, many bracks and ſhort ends which cannot be ſpun into an even piece, and in mine, a faire coherence throughout; I ſhall promiſe my ſelfe a favourable doome from them, and that they will have an acquieſcence in themſelves to what I have here preſented them with: whereas, if they but ravell it over looſely, & pitch upon diſputing

ting againſt particular concluſions, that at the firſt encounter of them ſingle, may ſeem harſh unto them, (which is the ordinary courſe of flaſhy wits, who cannot fadome the whole extent of a large diſcourſe) it is impoſsible but that they ſhould be very much unſatisfyed of me; and goe away with a perſwaſion, that ſome ſuch truths as upon the whole matter are moſt evident (one ſtone in the arch ſupporting another, and the whole) are meere chymeras and wild paradoxes.

But (Sonne) it is time my Booke ſhould ſpeake it ſelfe, rather then I ſpeak any longer of it here. Read it carefully over, and let me ſee by the effects of your governing your ſelf, that you make ſuch right uſe of it, as I may be comforted in having choſen you to bequeath it unto. God in heaven bleſſe you. *Paris* the laſt of *Auguſt*, 1644.

*Your Loving Father,*

KENELME DIGBY.

# THE PREFACE.

*THis writing was designed to have seen the light under the name of one Treatise. But after it was drawn in paper; as I cast a view over it, I found the Proœmiall part (which is that which treateth of Bodies) so ample in respect of the other (which was the end of it; and for whose sake I medled with it) that I readily apprehended my Reader would think I had gone much astray from my Text, when proposing to speak of the Immortality of Mans Soule, three parts of foure of the whole Discourse, should not so much as in one word mention that soule, whose nature and proprieties I aymed at the discovery of. To avoid this incongruity, occasioned me to change the name and unity of the work; and to make the survay of bodies, a body by it selfe: though subordinate to the Treatise of the Soule. Which notwithstanding it be lesse in bulke then the other, yet I dare promise my Reader, that if he bestow the paines requisite to perfect himselfe in it, he will find as much time well spent in the due reading of it, as in the reading of the former Treatise, though far more large.*

*But I discerne an Objection obvious to be made, or rather a Question; Why I should spend so much time in the consideration of Bodies, whereas none that hath formerly written of this subject, hath in any measure done the like?*

*I might answer that they had, upon other occasions, first written of the nature of Bodies: as I may instance in* Aristotle;

ſtotle; *and ſundry others, who either have themſelves profeſſedly treated the Science of Bodies, or have ſuppoſed that part ſufficiently performed by other pens. But truly, I was by an unavoidable neceſsity hereunto obliged: which is, a current of doctrine that at this day, much raigneth in the Chriſtian Schooles, where bodies and their operations, are explicated after the manner of ſpirituall things. For we having very ſlender knowledge of ſpirituall ſubſtances, can reach no further into their nature, then to know that they have certaine powers, or qualities; but can ſeldome penetrate ſo deep, as to deſcend to the particulars of ſuch Qualities, or Powers. Now our modern Philoſophers have introduced ſuch a courſe of learning into the Schooles, that unto all queſtions concerning the proper natures of Bodies, and their operations, it is held ſufficient to anſwer, they have a quality, or a power to doe ſuch a thing. And afterwards they diſpute whether this Quality or Power, be an Entity diſtinct from its ſubject, or no; and how it is ſeparable, or unſeparable from it, and the like. Conformable to this, who will looke into the books, which are in vogue in theſe Schools, ſhall find ſuch anſwers and ſuch controverſies every where, and few others. As, of the ſenſible qualities: aske what it is to be white or red, what to be ſweet or ſowre, what to be odoriferous or ſtinking, what to be cold or hot? And you are preſently paid with, that it is a ſenſible quality, which hath the power to make a wall white or red, to make a meat agreeable or diſagreeable to the taſte, to make a gratefull or ungratefull ſmell to the noſe, &c. Likewiſe they make the ſame queſtions and reſolutions, of Gravity and Levity: as whether they be qualities, that is, entities diſtinct from their ſubject: and whether they be active or paſsive; which when they have diſputed ſlightly, and in common, with Logicall arguments; they reſt there, without any further ſearching into the phyſicall cauſes or effects of them. The like you ſhal find of all ſtrange effects*

*of them. The Load-ſtone and Electricall bodies are produced for miraculous, and not underſtandable things; and in which, it muſt be acknowleaged, that they work by hidden qualities, that mans wit cannot reach unto. And aſcending to living bodies, they give it for a Maxime: that life is the action of the ſame Entity upon it ſelfe: that ſenſe is likewiſe a worke of an intrinſecall power, in the part we call Senſe, upon it ſelfe. Which, our predeceſſors held the greateſt abſurdities that could be ſpoken in Phyloſophie. Even ſome Phyſitians, that take upon them to teach the curing of our bodies, doe often pay us with ſuch termes; among them, you have long diſcourſes of a retentive, of an expulſive, of a purging, of a conſolidating faculty: and ſo of every thing that either paſſeth in our body, or is applyed for remedy. And the meaner ſort of Phyſitians know no more, but that ſuch faculties are; though indeed they that are truly Phyſitians, know alſo in what they conſiſt; without which knowledge it is much to be feared, Phyſitians will doe more harme then good.*

*But to returne to our ſubject: this courſe of doctrine in the Schools, hath forced me to a great deale of paines in ſeeking to diſcover the nature of all ſuch actions (or of the maine part of them) as were famed for incomprehenſible: for what hope could I have, out of the actions of the ſoule to convince the nature of it to be incorporeall; if I could give no other account of bodies operations, then that they were performed by qualities occult, ſpecificall, or incomprehenſible? Would not my adverſary preſently anſwer, that any operation, out of which I ſhould preſſe the ſoules being ſpir tuall, was performed by a corporeall occult quality: and that as he muſt acknowledge it to be incomprehenſible, ſo muſt I likewiſe acknowledge other qualities of bodies, to be as incomprehenſible: & therfore could not with reaſon preſſe him, to ſhew how a body was able to doe ſuch an operation: as I ſhould inferre muſt of neceſsity proceed from*

*from a ſpirit, ſince that neither could I give account how the loadſtone drew iron, or looked to the North; how a ſtone, and other heavy things were carried downewards; how ſight or fantaſie was made; how digeſtion or purging were effected; and many other ſuch queſtions, which are ſo ſlightly reſolved in the Schooles?*

*Beſides this reaſon, the very deſire of knowledge in my ſelf; and a willingneſſe to be available unto others (at the leaſt ſo farre as to ſet them on ſeeking for it, without having a prejudice of impoſsibility in attaining it) was unto me a ſufficient motive, to inlarge my diſcourſe to the bulk it is riſen unto. For what a miſery is it, that the flower and beſt wits of Chriſtendome, which flock to the Vniverſities, under pretence and upon hope of gaining knowledge, ſhould be there deluded; and after many yeares of toyle and expence, bee ſent home againe, with nothing acquired more then a faculty, and readineſſe to talke like Parrats of many things; but not to underſtand ſo much as any one; and withall with a perſwaſion that in truth nothing can be knowne? For ſetting knowledge aſide, what can it availe a man to be able to talke of any thing? What are thoſe wranglings, where the diſcovery of truth is neither ſought, nor hoped for, but meerly vanity and oſtentation? Doth not all tend, to make him ſeem and appeare that which indeed he is not? Nor let any body take it ill at my hands, that I ſpeak thus of the modcrne Schooles: for indeed it is rather themſelves then I that ſay it. Excepting Mathematicks, let all the other Schooles pronounce their owne minds, and ſay ingeniouſly, whether they themſelves beleeve they have ſo much as any one demonſtration, from the beginning to the ending of the whole courſe of their learning. And if all, or the moſt part, will agree that any one poſition is demonſtrated perfectly, and as it ought to bee, and as thouſands of concluſions are demonſtrated in Mathematickes; I am ready to undergoe*

the blame of having calumniated them, and will as readily make them amends. But if they neither will, nor can; then their owne verdict cleareth me: and it is not so much I, as they, that make this profession of the shallownesse of their doctrine. And to this purpose I have often heard the lamentations of divers, as great wits as any that converse in the Schooles, complaining of this defect. But in so great an evidence of the effect, proofes are superfluous.

Wherefore I will leave this subject, to declare what I have here designed, and gone about, towards the remedy of this inconvenience. Which is, that whereas in the Schooles, there is a loose method, or rather none; but that it is lawfull, by the liberty of a Commentator, to handle any question, in any place (which is the cause of the slightnesse of their doctrine, and can never be the way to any science or certitude) I have taken my beginnings from the commoneſt things that are in nature: namely, from the notions of Quantity, and its first differences: which are the most simple, and radicall notions that are, and in which all the rest are to be grounded. From them I endeavour by immediate composition of them, and derivation from them, to bring downe my discourse to the Elements, which are the primary and most simple bodies in nature. From these, I proceed to compounded bodies; first, to those that are called mixed; and then, to living bodies: declaring in common the proprieties and operations that belong unto them. And by occasion as I passe along, I light here and there on those operations, which seem most admirable in nature, to shew how they are performed; or at the least, how they may be performed: that though I misse in particular of the industry of nature, yet I may nevertheleſſe hit my intent; which is, to trace out a way, how these, and such like operations may be effected by an exact disposition, and ordering (though intricate) of quantitative and corporeall parts: and to shew, that they oblige us not to

recurre

*recurre unto hidden and unexplicable qualities. And if I have declared ſo many of theſe, as may beget a probable perſwaſion in my reader, that the reſt, which I have not touched, may likewiſe be diſplayed, and ſhewed to ſpring out of the ſame grounds, if curious and conſtant ſearchers into nature, will make their taske to penetrate into them; I have therein obtained my deſire and intent; which is onely, to ſhew from what principles, all kinds of corporeall operations doe proceed; and what kind of operations all theſe muſt be, which may iſſue out of theſe principles: to the end, that I may from thence, make a ſtep to raiſe my diſcourſe to the contemplation of the ſoule; and ſhew, that her operations are ſuch, as cannot proceed from thoſe principles; which being adequate and common to all bodies, we may reſt aſſured, that what cannot iſſue from them, cannot have a body for its ſource.*

*I will therefore end this preface, with entreating my Reader to conſider, that in a diſcourſe proceeding in ſuch order as I have declared, he muſt not expect to underſtand, and be ſatisfied, with what is ſaid in any middle or latter part, unleſſe he firſt have read, and underſtood what goeth before. Wherefore, if he cannot reſolve with himſelfe, to take it along orderly as it lyeth from the beginning, he ſhall doe himſelfe (as well as me) right, not to meddle at all with this booke. But if hee will employ any time upon it, to receive advantage by it, he muſt be content to take the paines to underſtand throughly every particular as it is ſet downe. And if his memory will not ſerve him to carry every one along with him, yet at the leaſt, let him be ſure to remember the place where it is handled, and upon occaſion, return a look back upon it, when it may ſtand him in ſtead. If he thinketh this diligence too burthenſome, let him conſider that the writing hereof hath coſt the Authour much more pains: who as he will eſteem them exceedingly well employed, if they may contribute ought to the content or advan-*

*tage*

*tage of any free and ingenuous mind; so if any others shall expresse a neglect of what he hath with so much labour hewed out of the hard rock of Nature; or shall discourteously cavill at the notions he so freely imparteth unto them; all the resentment he shall make thereof, will be to desire the first, to consider, that their slight esteeme of his worke, obligeth them to entertaine their thoughts with some more noble and more profitable subject, and better treated, then this is: and the later sort, to justifie their dislike of his doctrine, by delivering a fairer and more complete body of Philosophy, of their owne. Which if hereupon they doe, his being the occasion of the ones bettering themselves, and of the others bettering the world, will be the best successe he can wish his Booke.*

# A Table shewing what is contained in the severall Chapters and Sections in this *Treatise* concerning BODIES.

The figures after the Chapters, are the Sections belonging to every Chapter: which Sections the Reader shall find in every Chapter by their figures in the margine.


## CHAP. I.

THe Preface. A Preamble to the whole discourse; concerning notions in generall.

1. Quantity *is the first, and most obvious affection of a body.*
2. *Words do not expresse things as they are in themselves, but onely as they are painted in the minds of men.*
3. *The first errour that may arise from hence; which is a multiplying of things, where no such multiplycation is really found.*
4. *A second errour; the conceiving of many distinct things as really one thing.*
5. *Great care to be taken to avoid the errours which may arise from our manner of understanding things.*
6. *Two sorts of words to expresse our notions, the one common to all men, the other proper to schollers.*
7. *Great errours arise by wresting words from their common meaning to expresse a more particular or studied notion.*

## CHAP. II.

Of Quantity.

1. *We must know the vulgar and common notion of Quantity that we may understand the nature of it.*
2. *Extension or divisibilitie is the common notion of Quantity.*
3. *Parts of Quantity are not actually in their whole.*
4. *If parts were actually in their whole, Quantity would be composed of indivisibles.*
5. *Quantity cannot be composed of indivisibles.*
6. *An objection to prove that parts are actually in Quantitie; with a declaration of the mistake from whence it proceedeth.*
7. *The solution of the former objection: and that sense cannot discern whether one part be distinguished from another, or no.*
8. *An enumeration of the severall*

*specieſes of Quantity, which confirmeth that the eſſence of it is diviſibilitie.*

CHAP. III.

Of Rarity and Denſity.

1. *What is meant by Rarity and Denſity.*
2. *It is evident that ſome bodies are rare and others denſe; though obſcure, how they are ſuch.*
3. *A brief enumeration of the ſeverall properties belonging to rare and denſe bodies.*
4. *The opinion of thoſe Philoſophers declared, who put rarity to conſiſt in an actuall diviſion of a body into little parts.*
5. *The former opinion rejected, and the ground of their errour diſcovered.*
6. *The opinion of thoſe Philoſophers related, who put rarity to conſiſt in the mixtion of vacuity among bodies.*
7. *The opinion of vacuities refuted.*
8. *Rarity and Denſity conſiſt in the ſeverall proportions which Quantity hath to its ſubſtance.*
9. *All muſt admit in Phyſicall bodies, a Metaphyſicall compoſition.*

CHAP. IV.

Of the foure firſt qualities: and of the foure Elements.

1. *The notions of denſity and rarity have a latitude capable of infinite variety.*
2. *How moiſtneſſe and drineſſe are begotten in denſe bodies.*
3. *How moiſtneſſe and dryneſſe are begotten in rare bodies.*
4. *Heat is a property of rare bodies, and cold of denſe ones.*
5. *Of the two denſe bodies, the leſſe denſe is more cold: but of the two rare ones, the leſſe rare is leſſe hot.*
6. *The extreme denſe body is more drie, then the extreme rare one.*
7. *There are but foure ſimple bodies: and theſe are rightly named Elements.*
8. *The Authour doth not determine whether every element doth comprehend under its name one onely loweſt ſpecies, or many: nor whether any of them be found pure.*

CHAP. V.

Of the operations of the Elements in generall. And of their Activities compared with one another.

1. *The firſt operation of the Elements is diviſion, out of which reſult-*

*reſulteth locall motion.*
2. *What place is both notionally, and really.*
3. *Locall motion is that diviſion, whereby a body changeth its place.*
4. *The nature of quantity of it ſelf is ſufficient to unite a body to its place.*
5. *All operations amongſt bodies are either locall motion, or ſuch as follow out of locall motion.*
6. *Earth compared to water in activity.*
7. *The manner whereby fire getteth into fewell, proveth that it exceedeth earth in activity.*
8. *The ſame is proved by the manner, whereby fire cometh out of fewell and worketh upon other bodies.*

## CHAP. VI.

### Of Light, what it is.

1. *In what ſenſe the Author rejecteth qualities.*
2. *In what ſenſe the Author doth admit of qualities.*
3. *Five arguments propoſed to prove that light is not a body.*
4. *The two firſt reaſons to prove light to be a body are, the reſemblance it hath with fire; and becauſe if it were a quality, it would alwayes produce an equal to it ſelf.*
5. *The third reaſon, becauſe if we imagine to our ſelves the ſubſtance of fire to be rarified, it will have the ſame appearences which light hath.*
6. *The fourth reaſon, from the manner of the generation and corruption of light, which agreeth with fire.*
7. *The fifth reaſon, becauſe ſuch properties belong to light as agree onely unto bodies.*

## CHAP. VII.

### Two objections anſwered againſt light being fire, a more ample proofe of its being ſuch.

1. *That all light is hot and apt to heat.*
2. *The reaſon why our bodies for the moſt part do not feel the heat of pure light.*
3. *The experience of burning glaſſes, and of ſoultry gloomy weather, prove light to be fire.*
4. *Philoſophers ought not to judge of things by the rules of vulgar people.*
5. *The different names of lighs and fire, proceed from different notions of the ſame ſubſtance.*
6. *The reaſon why many times fire and heat are deprived of light.*
7. *What becometh of the body of light when it dieth.*

8. *An experiment of some who pretend, that light may be precipitated into powder.*
9. *The Authors opinion concerning lamps, pretended to have been found in tombes, with inconsumptible lights.*

## CHAP. VIII.

An answer to three other objections formerly proposed, against light being a substance.

1. *Light is not really in every part of the room it enlightneth, nor filleth entirely any sensible part of it, though it seem to us to do so.*
2. *The least sensible point of a diaphanous body, hath room sufficient to contain both aire and light, together with a multitude of beams issuing from severall lights without penetrating one another.*
3. *That light doth not enlighten any room in an instant, and that the great celerity of its motion doth make it inperceptible to our senses.*
4. *The reason why the motion of light, is not discerned coming towards us, and that there is some reall tardity in it.*
5. *The planets are not certainly ever in that place where they appear to be.*
6. *The reason why light being a body, doth not by its motion shatter other bodies into pieces.*
7. *The reason why the body of light is never perceived to be fanned by the wind.*
8. *The reasons for, and against lights being a body, compared together.*
9. *A summary repetition of the reasons which prove that light is fire.*

## CHAP. IX.

Of locall motion in common.

1. *No locall motion can be performed without succession.*
2. *Time is the common measure of all succession.*
3. *What velocity is, and that it cannot be infinite.*
4. *No force so little, that is not able to move the greatest weight imaginable.*
5. *The chief principle of Mechanicks, deduced out of the former discourse.*
6. *No moveable can passe from rest to any determinate degree of velocity, or from a lesser degree to a greater, without passing through all the intermediate degrees which are below the obtained degree.*
7. *The conditions which help to motion, in the moveable are three; in the medium, one.*
8. *No body hath any intrinsecall virtue to move it self towards any determinate part of the universe.*
9. *The*

9. *The encreaſe of motion is alwayes made in the proportion of the odde numbers.*
10. *No motion can encreaſe for ever, without coming to a period.*
11. *Certain problemes reſolved concerning the proportion of ſome moving Agents compared to their effects.*
12. *When a moveable cometh to reſt, the motion doth decreaſe according to the rules of encreaſe.*

## CHAP. X.

Of Gravity and Levity; and of locall Motion, commonly termed Naturall.

1. *Thoſe motions are called naturall, which have conſtant cauſes; and thoſe violent, which are contrary to them.*
2. *The firſt and moſt generall operation of the ſunne, is the making and raiſing of atomes.*
3. *The light rebounding from the earth with atomes, cauſeth two ſtreams in the aire; the one aſcending, the other deſcending; and both of them in a perpendicular line.*
4. *A denſe body placed in the aire between the aſcending and deſcending ſtream, muſt needs deſcend.*
5. *A more particular explication of all the former doctrine touching gravity.*
6. *Gravity and levity do not ſignifie an intrinſecall inclination to ſuch a motion in the bodies themſelves which are termed heavy and light.*
7. *The more denſe a body is, the more ſwiftly it deſcendeth.*
8. *The velocity of bodies deſcending doth not encreaſe in proportion to the difference that may be between their ſeverall denſities.*
9. *More or leſſe gravity doth produce a ſwifter or a ſlower deſcending of a heavy body. Ariſtotles argument to diſprove motion* in vacuo, *is made good.*
10. *The reaſon why at the inferior quarter of a circle, a body doth deſcend faſter by the arch of that quarter, then by the cord of it.*

## CHAP. XI.

An anſwer to objections againſt the cauſes of naturall motion, avowed in the former chapter; and a refutation of the contrary opinion.

1. *The firſt objection anſwered; why a hollow body deſcendeth ſlower then a ſolid one.*
2. *The ſecond objection anſwered and the reaſons ſhown, why atomes do continually overtake*

*the descending dense body.*

3. *A curious question left undecided.*
4. *The fourth objection answered, why the descent of the same heavy bodies, is equall in so great inequality of the atomes which cause it.*
5. *The reason why the shelter of a thick body doth not hinder the descent of that which is under it.*
6. *The reason why some bodies sink, others swimme.*
7. *The fifth objection answered concerning the descending of heavy bodies in streams.*
8. *The sixth objection answered; and that all heavy elements do weigh in their owne spheres.*
9. *The seventh objection answered, and the reason why we do not feel the course of the aire, and atomes that beat continually upon us.*
10. *How in the same body, gravity may be greater then density, and density then gravity; though they be the same thing.*
11. *The opinion of gravities being an intrinsecall inclination of a body to the center, refuted by reason.*
12. *The same opinion refuted by severall experiences.*

CHAP. XII.

Of violent Motion.

1. *The state of the question touching the cause of violent motion.*
2. *That the medium is the onely cause, which continueth violent motion.*
3. *A further explication of the former doctrine.*
4. *That the aire hath strength enough to continue violent motion in a moveable.*
5. *An answer to the first objection; that aire is not apt to conserve motion: and how violent motion cometh to cease.*
6. *An answer to the second objection, that the aire hath no power over heavy bodies.*
7. *An answer to the third objection, that an arrow should fly faster broad wayes then long wayes.*

CHAP. XIII.

Of three sorts of violent motion, Reflexion, Undulation, and Refraction.

1. *That reflexion is a kind of violent motion.*
2. *Reflection is made at equall angles.*
3. *The causes and properties of undulation.*

4. Re-

4. *Refraction at the entrance into the reflectent body is towards the perpendicular; at the going out, it is from it; when the second superficies is parallel to the first.*
5. *A refutation of Monsieurdes Cartes his explication of refraction.*
6. *An answer to the arguments brought in favour of Monsieur des Cartes his opinion.*
7. *The true cause of refraction of light both at its entrance, and at its going out from the reflecting body.*
8. *A generall rule to know the nature of reflection and refractions in all sorts of surfaces.*
9. *A body of greater parts and greater pores, maketh a greater refraction then one of lesser parts and lesser pores.*
10. *A confirmation of the former doctrine, out of the nature of bodies that refract light.*

## CHAP. XIV.

Of the composition, qualities, and generation of mixed bodies.

1. *The connexion of this chapter with the rest, and the Authors intent in it.*
2. *That there is a least cise of bodies; and that this least cise is found in fire.*
3. *The first conjunction of parts is in bodies of least cise; and it is made by the force of Quantity.*
4. *The second sort of conjunction, is compactednesse in simple Elements, and it proceedeth from densitie.*
5. *The third conjunction is of parts of different Elements, and it proceedeth from quantity and density together.*
6. *The reason why liquid bodies do easily joyn together; and dry ones difficultly.*
7. *That no two hard bodies can touch one another immediately.*
8. *How mixed bodies are framed in generall.*
9. *The cause of the severall degrees of solidity in mixed bodies.*
10. *The rule whereunto are reduced all the severall combinations of Elements in compounding of mixed bodies.*
11. *Earth and water are the basis of all permanent mixed bodies.*
12. *What kind of bodies those are where water is the basis, and earth the predominant Element over the other two.*
13. *Of those bodies, where water being the basis aire is the predominant Element.*
14. *What kind of bodies result, where water is the basis, and fire the predominant Element.*
15. *Of those bodies, where water*

*is in exceſſe, it alone being both the baſis, and the predominant Element.*

16. *Of thoſe bodies, where earth alone is the baſis, and alſo the predominant in exceſſe over the other three Elements.*

17. *Of thoſe bodies where earth is the baſis, & water the predominant element over the other two*

18. *Of thoſe bodies, where earth being the baſis aire is the predominant.*

19. *Of thoſe bodies, where earth being the baſis, fire is the predominant.*

20. *All the ſecond qualities of mixed bodies, ariſe from ſeverall combinations of the firſt qualities: and are at laſt reſolved into ſeverall degrees of rarity and denſity.*

21. *That in the planets and ſtarres there is a like variety of mixed bodies cauſed by light as here upon earth.*

22. *In what manner the Elements do work upon one another, in the compoſition of mixed bodies: and in particular fire which is the moſt active.*

23. *A particular declaration touching the generation of metals.*

CHAP. XV.

Of the diſſolution of mixed bodies.

1. *Why ſome bodies are brittle, and others tough, are apt to withſtand outward violence the firſt inſtrument to diſſolve mixed bodies.*

2. *How outward violence doth work upon the moſt compacted bodies.*

3. *The ſeverall effects of fire, the ſecond and chiefeſt inſtrument to diſſolve all compounded bodies*

4. *The reaſon why ſome bodies are not diſſolved by fire.*

5. *The reaſon why fire melteth gold, but cannot conſume it.*

6. *Why lead is eaſily conſumed and calcined by fire.*

7. *Why and how ſome bodies are divided by fire into ſpirits, waters, oyls, ſalts and earth. And what thoſe parts are.*

8. *How water the third inſtrument to diſſolve bodies diſſolveth calx into ſalt; and ſo into terra damnata.*

9. *How water mingled with ſalt, becometh a moſt powerfull Agent to diſſolve other bodies.*

10. *How putrefaction is cauſed.*

CHAP. XVI.

An explication of certain Maxims touching the operations, and qualities of bodies: and whether the Elements be found pure in any part of the world.

1. *What is the ſphere of activity in corporeall agents.*

2. *The*

2. *The reason why no body can work in distance.*
3. *An objection answered against the manner of explicating the former axiome.*
4. *Of reaction: and first in pure locall motion, that each Agent must suffer in acting and act in suffering.*
5. *The former doctrine applyed to other locall motions designed by particular names. And that Suisseths argument is of no force against this way of doctrine.*
6. *Why some notions do admit of intension and remission; and others do not.*
7. *That in every part of our habitable world; all the foure elements, are found pure in small atomes; but not in any great bulk.*

## CHAP. XVII.

Of rarefaction and condensation the two first motions of particular bodies.

1. *The Authours intent in this and the following chapters.*
2. *That bodies may be rarified, both by outward heat; and how this is performed.*
3. *Of the great effects of Rarefaction.*
4. *The first manner of condensation by heat.*
5. *The second manner of condensation by cold.*
6. *That yce is not water rarified but condensed.*
7. *How wind, snow, and hail are made; and wind by rain allaid.*
8. *How parts of the same or divers bodies, are joyned more strongly together by condensation.*
9. *Vacuities cannot be the reason, why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.*
10. *The true reason of the former effect.*
11. *The reason why bodies of the same nature do joyn more easily together then others.*

## CHAP. XVIII.

Of another motion belonging to particular bodies, called Attraction; and of certain operations termed Magicall.

1. *What Attraction is, and from whence it proceedeth.*
2. *The true sense of the Maxime, that* Nature abhorreth from vacuity.
3. *The true reason of attraction.*
4. *Water may be brought by the force of attraction to what height soever.*
5. *The doctrine touching the attraction of water in syphons.*
6. *That the syphon doth not prove water to weigh in its own orb.*



7. *Concerning*

7. *Concerning attraction caused by fire.*
8. *Concerning attraction made by virtue of hot bodies, amulets, &c.*
9. *The naturall reason given for divers operations, esteemed by some to be magicall.*

## CHAP. XIX.

Of three other motions belonging to particular bodies, Filtration, Restitution, and Electricall attraction.

1. *What is Filtration; and how it is effected.*
2. *What causeth the water in filtration to ascend.*
3. *Why the filter will not drop unlesse the label hang lower then the water.*
4. *Of the motion of Restitution: and why some bodies stand bent, others not.*
5. *Why some bodies return onely in part to their naturall figure; others entirely.*
6. *Concerning the nature of those bodies which do shrink and stretch.*
7. *How great and wonderfull effects, proceed from small, plain, and simple principles.*
8. *Concerning Electricall attraction, and the causes of it.*
9. *Cabeus his opinion refuted concerning the cause of Electricall motions.*

## CHAP. XX.

Of the Loadstones generation; and its particular motions.

1. *The extreme heat of the sunne under the zodiack, draweth a stream of aire from each Pole into the torrid zone.*
2. *The atomes of these two streams coming together are apt to incorporate with one another.*
3. *By the meeting and mingling together of these streams at the Equator, divers rivolets of atomes of each Pole, are continuated from one Pole to the other.*
4. *Of these atomes incorporated with some fit matter in the bowels of the earth, is made a stone.*
5. *This stone worketh by emanations, joyned with agreeing streams that meet them in the aire; and in fine it is a loadstone.*
6. *A methode for making experiences upon any subject.*
7. *The loadstones generation by atomes flowing from both Poles, is confirmed by experiments observed in the stone it self.*
8. *Experiments to prove that the loadstone worketh by emanations, meeting with agreeing streams.*

CHAP.

## CHAP. XXI.

Positions drawn out of the former doctrine, and confirmed by experimentall proofs.

1. *The operations of the loadstone are wrought by bodies and not by qualities.*
2. *Objections against the former position answered.*
3. *The loadstone is imbued with his vertue from another body.*
4. *The vertue of the loadstone is a double, and not one simple virtue.*
5. *The virtue of the loadstone worketh more strongly in the Poles of it, then in any other part.*
6. *The loadstone sendeth forth its emanations spherically. Which are of two kinds: and each kind is strongest in that hemisphere, through whose polary parts they issue out.*
7. *Putting two loadstones within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.*
8. *Concerning the declination and other respects of a needle, towards the loadstone it toucheth*
9. *The virtue of the loadstone goeth from end to end in lines almost parallell to the axis.*
10. *The virtue of a loadstone is not perfectly spherical though the stone be such.*
11. *The intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and the attracted bodies.*
12. *The main globe of the earth not a loadstone.*
13. *The loadstone is generated in all parts or climates of the earth*
14. *The conformity betwixt the two motions of magnetick things and of heavy things.*

## CHAP. XXII.

A solution of certain Problemes concerning the loadstone, and a short summe of the whole doctrine touching it.

1. *Which is the North, and which the South Pole of a loadstone.*
2. *Whether any bodies besides magnetick ones be attractive.*
3. *Whether an iron placed perpendicularly towards the earth doth get a magnetical virtue of pointing towards the north, or towards the south in that end that lieth downwards.*
4. *Why loadstones affect iron better then one another.*
5. *Gilberts reason refuted touching a capped loadstone, that taketh up more iron then one not capped; and an iron impregnated that in some case draweth more strongly then the stone it self.*
6. *Galileus his opinion touching*

*the former effects refuted.*
7. *The Authours solution to the former questions.*
8. *The reason why in the former case, a lesser loadstone doth draw the interjacent iron from the greater.*
9. *Why the variation of a touched needle from the north, is greater the nearer you go to the Pole.*
10. *Whether in the same part of the world a touched needle may at one time vary more from the north, and at another time lesse.*
11. *The whole doctrine of the loadstone summed up in short.*

## CHAP. XXIII.

A description of two sorts of living creatures; Plants and Animals: & how they are framed in common to perform vitall motion.

1. *The connexion of the following Chapters with the precedent ones.*
2. *Concerning severall compositions of mixed bodies.*
3. *Two sorts of living creatures.*
4. *An engine to expresse the first sort of living creatures.*
5. *An other engine by which may be expressed the second sort of living creatures.*
6. *The two former engines and some other comparisons applyed to expresse the two severall sorts of living creatures.*
7. *How plants are framed.*
8. *How sensitive creatures are formed.*

## CHAP. XXIIII.

A more particular survey of the generation of Animals; in which is discovered what part of the animal is first generated.

1. *The opinion that the seed containeth formally every part of the parent.*
2. *The former opinion rejected.*
3. *The Authours opinion of this question.*
4. *Their opinion refuted, who hold that every thing containeth formally all things.*
5. *The Authours opinion concerning the generation of Animals declared and confirmed.*
6. *That one substance is changed into another.*
7. *Concerning the hatching of chickens, and the generation of other animals.*
8. *From whence it happeneth that the deficiences or excrescences of the parents body, are often seen in their children.*
9. *The difference between the authours opinion, and the former one.*
10. *That the heart is imbued with the generall specifick virtues of the whole body; whereby is confirmed the doctrine of the two former paragraphs.*
11. *That*

11. *That the heart is the first part generated in a living creature.*

## CHAP. XXV.

How a Plant or Animal cometh to that figure it hath.

1. *That the figure of an Animal is produced by ordinary second causes, as well as any other corporeall effect.*
2. *That the severall figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrence of accidentall causes.*
3. *The former doctrine is confirmed by severall instances.*
4. *The same doctrine applyed to Plants.*
5. *The same doctrine declared in leafs of trees.*
6. *The same applyed to the bodies of Animals.*
7. *In what sense the Authour doth admit of* Vis formatrix.

## CHAP. XXVI.

How motion beginneth in living creatures. And of the motion of the heart, circulation of the bloud, Nutrition, Augmentation, and corruption or death.

1. *From whence doth proceed the primary motion and growth in Plants.*
2. *Monsieur des Cartes his opinion touching the motion of the heart.*
3. *The former opinion rejected.*
4. *The Authours opinion concerning the motion of the heart.*
5. *The motion of the heart dependeth originally of its fibers irrigated by bloud.*
6. *An objection answered against the former doctrine.*
7. *The circulation of the bloud, & other effects that follow the motion of the heart.*
8. *Of Nutrition.*
9. *Of Augmentation.*
10. *Of death and sickness.*

## CHAP. XXVII.

Of the motions of sense, and of the sensible qualities in generall, and in particular of those which belong to Touch, Taste, and Smelling.

1. *The connexion of the subsequent chapters with the precedent.*
2. *Of the senses and sensible qualities in generall. And of the end for which they serve.*
3. *Of the sense of touching: and that both it and its qualities are bodies.*
4. *Of the taste and its qualities: that they are bodies.*
5. *That the smell and its qualities are reall bodies.*
6. *Of the conformity betwixt the two senses of smelling & tasting*
7. *The*

7. *The reason why the sense of smelling is not so perfect in man as in beasts: with a wonderfull historie of a man who could wind a sent as well as any beast.*

## CHAP. XXVIII.

Of the sense of hearing, and of the sensible quality, sound.

1. *Of the sense of hearing: and that sound is purely motion.*
2. *Of divers arts belonging to the sense of hearing: all which confirm that sound is nothing but motion.*
3. *The same is confirmed by the effects caused by great noises.*
4. *That solid bodies may convey the motion of the aire or sound to the organe of hearing.*
5. *Where the motion is interrupted there is no sound.*
6. *That not onely the motion of the aire, but all other motions coming to our ears make sounds.*
7. *How one sense may supply the want of another.*
8. *Of one who could discern sounds of words with his eyes.*
9. *Divers reasons to prove sound to be nothing else but a motion of some reall body.*

## CHAP. XXIX.

Of sight and colours.

1. *That colours are nothing but light mingled with darknesse; or the disposition of a bodies superficies apt to reflect light so mingled.*
2. *Concerning the disposition of those bodies which produce white or black colours.*
3. *The former doctrine confirmed by Aristotles authority, reason, and experience.*
4. *How the diversity of colours do follow out of various degrees of rarity and density.*
5. *Why some bodies are diaphanous others opacous.*
6. *The former doctrine of colours confirmed by the generation of white and black in bodies.*

## CHAP. XXX.

Of luminous or apparent colours.

1. *Apparitions of colours through a prisme or triangular glasse are of two sorts.*
2. *The severall parts of the object make severall angles at their entrance into the prisme.*
3. *The reason why sometimes the same object appears through the prisme in two places: and in one place more lively, in the other place more dimme.*
4. *The reason of the various colours that appear in looking thorough a prisme.*
5. *The reason why the prisme in one position, may make the colours appear quite contrary to what*

*what they did, when it was in another position.*
6. *The reason of the various colours in generall, by pure light passing through a prisme.*
7. *Upon what side every colour appears that is made by pure light passing through a prisme.*

CHAP. XXXI.

The causes of certain appearances in luminous colours; with a conclusion of the discourse touching the senses & the sensible qualities

1. *The reason of each severall colour in particular caused by light passing through a prisme.*
2. *A difficult probleme resolved touching the prisme.*
3. *Of the rainbow, and how by the colour of any body, we may know the composition of the body it self.*
4. *That all the sensible qualities are reall bodies resulting out of severall mixtures of rarity and densitie.*
5. *Why the senses are onely five in number: with a conclusion of all the former doctrine concerning them.*

CHAP. XXXII.

Of sensation, or the motion whereby sense is properly exercised.

1. *Monsieur des Cartes his opinion touching sensation.*
2. *The Authors opinion touching sensation.*
3. *Reasons to perswade the Authours opinion.*
4. *That vitall spirits are the immediate instruments of sensation by conveying sensible qualities to the brain.*
5. *How sound is conveyed to the brain by vitall spirits.*
6. *How colours are conveyed to the brain by vitall spirits.*
7. *Reasons against Monsieur des Cartes his opinion.*
8. *That the symptomes of the palsie, do no way confirm Monsieur des Cartes his opinion.*
9. *That Monsieur des Cartes his opinion, cannot give a good account, how things are conserved in the memory.*

CHAP. XXXIII.

Of Memory.

1. *How things are conserved in the memory.*
2. *How things conserved in the memory are brought back into the phantasie.*
3. *A confirmation of the former doctrine.*
4. *How things renewed in the phantasie, return with the same circumstances that they had at first.*
5. *How the memory of things past is lost, or confounded: and how it is repaired again.*

CHAP.

## CHAP. XXXIV.

Of voluntary motion, naturall faculties, and passions.

1. *Of what matter the brain is composed.*
2. *What is voluntary motion.*
3. *What those powers are which are called naturall faculties.*
4. *How the attractive and secretive faculties work.*
5. *Concerning the concoctive faculties.*
6. *Concerning the retentive and expulsive faculties.*
7. *Concerning expulsion made by Physick.*
8. *How the brain is moved to work voluntary motion.*
9. *Why pleasing objects do dilate the spirits, and displeasing ones contract them.*
10. *Concerning the five senses for what use and end they are.*

## CHAP. XXXV.

Of the materiall instrument of Knowledge and Passion; of the severall effects of Passions; of Pain and Pleasure; and how the vitall spirits are sent from the brain into the intended parts of the body, without mistaking their way.

1. *That* Septum Lucidum *is the seat of the phansie.*
2. *What causeth us to remember not onely the object it self, but also that we have thought of it before.*
3. *How the motions of the phantasie, are derived to the heart.*
4. *Of pain and pleasure.*
5. *Of Passion.*
6. *Of severall pulses caused by passions.*
7. *Of severall other effects caused naturally in the body by passions*
8. *Of the diaphragma.*
9. *Concerning pain and pleasure caused by the memory of things past.*
10. *How so small bodies as atomes are, can cause so great motions in the heart.*
11. *How the vitall spirits sent from the brain, do runne to the intended part of the body without mistake.*
12. *How men are blinded by passion*

## CHAP. XXXVI.

Of some actions of beasts, that seem to be formall acts of reason, as doubting, resolving, inventing.

1. *The order and connexion of the subsequent chapters.*
2. *From whence proceedeth the doubting of beasts.*
3. *Concerning the invention of foxes and other beasts.*
4. *Of foxes that catch hens by lying under their roost, and by gazing upon them.*

5. *From*

5. *From whence proceeds the foxes invention to rid himself of fleas*
6. *An explication of two other inventions of foxes.*
7. *Concerning Montagues argument, to prove that dogs make syllogismes.*
8. *A declaration how some tricks are performed by foxes, which seem to argue discourse.*
9. *Of the Jaccatrays invention in calling beasts to himself.*
10. *Of the Jaccalls designe in serving the Lion.*
11. *Of severall inventions of fishes.*
12. *A discovery of divers things done by hares, which seem to argue discourse.*
13. *Of a foxe reported to have weighed a goose, before he would venture with it over a river, and of fabulous stories in common.*
14. *Of the severall cryings & tones of beasts: with a refutation of those authors who maintain thẽ to have compleat languages.*

## CHAP. XXXVII.

Of the docility of some irrationall animals, and of certain continuate actions of a long tract of time so orderly performed by them, that they seem to argue knowledge in them.

1. *How hawkes and other creatures are taught to do what they are brought up to.*
2. *Of the Baboon that played on a guitarre.*
3. *Of the teaching of Elephants & other beasts to do divers tricks.*
4. *Of the orderly train of actions performed by beasts in breeding their young ones.*

## CHAP. XXXVIII.

Of prescience of future events, providencies, the knowing of things never seen before; and such other actions, observed in some living creatures, which seem to be even above the reason that is in man himself.

1. *VVhy beasts are affraid of men.*
2. *How some qualities caused at first by chance in beasts, may passe by generation to the whole offspring.*
3. *How the parents phantasie doth oftentimes work strange effects in their issue.*
4. *Of Antipathies.*
5. *Of Sympathies.*
6. *That the Antipathy of beasts towards one an other, may be taken away by assuefaction.*
7. *Of longing marks seen in childrẽ*
8. *Why divers men hate some certain meats, & particularly cheese*
9. *Concerning the providence of Ants in laying up in store for winter.*
10. *Concerning the foreknowing of beasts.*

The conclusion of the first Treatise.

* * *

# A Table shewing what is contained in the severall Chapters and Sections in this second *Treatise*, Concerning *MANS SOUL.*

## CHAP. I.


THe Preface. Of simple Apprehensions.

1. *What is a right apprehension of a thing.*
2. *The very thing it self is truly in his understanding, who rightly apprehendeth it.*
3. *The apprehension of things coming unto us by our senses, are resolvable into other more simple apprehensions.*
4. *The apprehension of a* Being *is the most simple and* Basis *of all the rest.*
5. *The apprehension of a* thing *is in next degree to that of* Being, *and it is the* Basis *of all the subsequent ones.*
6. *The apprehension of things known to us by our senses doth consist in certain respects betwixt two things.*
7. *Respect or relation hath not really any formall being, but onely in the apprehension of man.*
8. *That* Existence *or* Being *is the proper affection of man: and that mans soul is a comparing power.*
9. *A thing by coming into the understanding of man, loseth nothing of its own peculiar nature.*
10. *A multitude of things may be united in mans understanding without being mingled or confounded together.*
11. *Of abstracted and concrete terms.*
12. *Of universall notions.*
13. *Of apprehending a multitude under one notion.*
14. *The power of the understanding reacheth as farre as the extent of* Being.


## CHAP. II.

Of Thinking and Knowing.


1. *How a judgement is made by the understanding.*
2. *That two or more apprehensions are identified in the soul by uniting them in the stock of* being
3. *How the notions of a substantive and an adjective are united in the soul by the common stock of* Being.
4. *That a settled judgement becometh a part of our soul.*
5. *How the soul cometh to deem or settle a judgement.*
6. *How opinion is begotten in the understanding.*
7. *How faith is begotten in the understanding.*





8. *Why*

8. *Why truth is the perfection of a reasonable soul: and why it is not found in simple apprehensions as well as in Enuntiations.*
9. *What is a solid judgement, and what a slight one.*
10. *What is an acute judgement, and what a dull one.*
11. *In what consisteth quickness and clearness of judgement: and there opposite vices.*

## CHAP. III.

### Of Discoursing.

1. *How discourse is made.*
2. *Of the figures and moods of syllogismes.*
3. *That the life of man as man, doth consist in discourse, and of the vast extent of it.*
4. *Of humane actions, and of those that concern our selves.*
5. *Of humane actions as they concern our neighbours.*
6. *Of Logick.*
7. *Of Grammar.*
8. *Of Rhetorick.*
9. *Of Poetry.*
10. *Of the power of speaking.*
11. *Of arts that concern dumbe and insensible creatures.*
12. *Of Arithmetick.*
13. *Of Prudence..*
14. *Observations upon what hath been said in this chapter.*

## CHAP. IV.

### How a man proceedeth to action.

1. *That humane actions proceed from two severall principles, understanding and sense.*
2. *How our generall and inbred maximes do concurre to humane action.*
3. *That the rules and maximes of arts do work positively in us, though we think not of them.*
4. *How the understanding doth cast about when it wanteth sufficient grounds for action.*
5. *How reason doth rule over sense and passion.*
6. *How we recall our thoughts from distractions.*
7. *How reason is sometimes overcome by sense and passion.*

## CHAP. V.

### Containing proofs out of our single apprehensions, that our soul is incorporeall.

1. *The connection of the subsequent chapters with the precedent.*
2. *The existence of corporeall things in the soul by the power of apprehension, doth prove her to be immateriall.*
3. *The notion of* being, *which is innate in the soul, doth prove the same.*
4. *The same is proved by the notion of* respects.

5. *That*

5. *That corporeall things are ſpiritualized in the underſtanding, by means of the ſouls working in and by reſpects.*
6. *That the abſtracting of notions from all particular and individuall accidents, doth prove the immaterialitie of the ſoul.*
7. *That the univerſalitie of abſtracted notions do prove the ſame.*
8. *That collective apprehenſions do prove the ſame.*
9. *The operations of the ſoul drawing alwayes from multitude to unitie, do prove the ſame.*
10. *The difference betwixt the notion of a thing in our underſtanding, and the impreſſion that correſpondeth to the ſame thing in our phanſie, doth prove the ſame.*
11. *The apprehenſion of negations & privations do prove the ſame.*

## CHAP. VI.

Containing proofs of our ſouls operations in knowing or deeming any thing, that ſhe is of a ſpirituall nature.

1. *The manner of judging or deeming by apprehending two things to be identified, doth prove the ſoul to be immateriall.*
2. *The ſame is proved by the manner of apprehending oppoſition in a negative judgement.*
3. *That things in themſelves oppoſite to one another having no oppoſition in the ſoul, doth prove the ſame.*
4. *That the firſt truths are identified to the ſoul.*
5. *That the ſoul hath an infinite capacity, and conſequently is immateriall.*
6. *That the oppoſition of contradictory propoſitions in the ſoul doth prove her immaterialitie.*
7. *How propoſitions of* eternall truth, *do prove the immaterialitie of the ſoul.*

## CHAP. VII.

That our diſcourſing doth prove our ſoul to be incorporeall.

1. *That in diſcourſing the ſoul containeth more in it at the ſame time then is in the phantaſie, which proveth her to be immateriall.*
2. *That the nature of diſcourſe doth prove the ſoul to be ordered to infinite knowledge, and conſequently immateriall.*
3. *That the moſt naturall objects of the ſoul are immateriall, & conſequently the ſoul her ſelf is ſuch*

## CHAP. VIII.

Containing proofs out of our manner of proceeding to action, that our ſoul is incorporeall.

1. *That the ſouls being a power to order things, proveth her to be immateriall.*

2. That the souls being able to move without being moved, doth prove her to be immateriall.
3. That the souls proceeding to action with an universality, and indifferency doth prove the same.
4. That the quiet proceeding of reason doth prove the same.
5. A conclusion of what hath been said hitherto in this second Treatise.

## CHAP. IX.

That our soul is a *Substance*, and *Immortall*.

1. That Mans soul is a substance.
2. That man is compounded of some other substance besides his body.
3. That the soul doth subsist of it self independently of the body.
4. Two other arguments to prove the same: one positive, the other negative.
5. The same is proved because the soul cannot be obnoxious to the cause of mortality.
6. The same is proved because the soul hath no contrary.
7. The same is proved from the end, for which the soul was created.
8. The same is proved because she can move without being moved.
9. The same is proved from her manner of operation which is grounded in being.
10. Lastly, it is proved from the science of Moralitie, the principles whereof would be destroyed, if the soul were mortall.

## CHAP. X.

Declaring what the soul of a man separated from his body, is: and of her knowledge and manner of working.

1. That the soul is one simple knowing act, which is a pure substance, and nothing but substance.
2. That a separated soul is in no place, and yet is not absent from any place.
3. That a separated soul is not in time, nor subject to it.
4. That the soul is an active substance, and all in it is activitie.
5. A description of the soul.
6. That a separated soul knoweth all that which she knew whilest she was in her body.
7. That the least knowledge which the soul acquireth in her body of any one thing, doth cause in her, when she is separated from her body a complete knowledge of all things whatsoever.
8. An answer to the objections of some Peripateticks, who maintain

*tain the ſoul to periſh with the body.*

9. *The former Peripateticks refuted out of Ariſtotle.*

10. *The operations of a ſeparated ſoul compared to her operations in her body.*

11. *That a ſeparated ſoul is in a ſtate of pure* being, *and conſequently immortall.*

## CHAP. XI.

Shewing what effects the divers manners of living in this world do cauſe in a ſoul, after ſhe is ſeparated from her body.

1. *That a ſoul in this life is ſubject to mutation, and may be perfected in knowledge.*

2. *That the knowledges which a ſoul getteth in this life, will make her knowledge in the next life more perfect and firm.*

3. *That the ſouls of men addicted to ſcience whileſt they lived here, are more perfect in the next world, then the ſouls of unlearned men.*

4. *That thoſe ſouls which embrace virtue in this world, will be moſt perfect in the next; and thoſe which embrace vice, moſt miſerable.*

5. *The ſtate of a vitious ſoul in the next life.*

6. *The fundamentall reaſon why as well happineſſe as miſery is ſo exceſſive in the next life.*

7. *The reaſon why mans ſoul requireth to be in a body, and to live for ſome ſpace of time joyned with it.*

8. *That the miſery of the ſoul in the next world proceedeth out of inequality, and not out of falſity of her judgements.*

## CHAP. XII.

Of the perſeverance of a ſoul, in the ſtate ſhe findeth her ſelf in, at her firſt ſeparation from her body

1. *The explication, and proof of that maxime, that,* If the cauſe be in act, the effect muſt alſo be.

2. *The effects of all ſuch agents as work inſtantaneouſly, are complete in the firſt inſtant that the agents are put.*

3. *All pure ſpirits do work inſtantaneouſly.*

4. *That a ſoul ſeparated from her body, cannot ſuffer any change after the firſt inſtant of her ſeparation.*

5. *That temporall ſinnes are juſtly puniſhed with eternall pains.*

# THE FIRST TREATISE DECLARING *THE NATURE AND OPERATION OF* BODIES.

## CHAP. I.

### *A Preamble to the whole discourse: Concerning Notions in generall.*

IN delivering any Science, the cleareſt and ſmootheſt methode, and moſt agreeable to nature, is to begin with the conſideration of thoſe things that are moſt common and obvious; and by the diſſection of them to deſcend by orderly degrees and ſteps (as they lie in the way) unto the examination of the moſt particular and remote ones. Now in our preſent intended ſurvey of a Bodie, the firſt thing which occurreth to our ſenſe in the peruſall of it, is its *Quantitie*, bulk, or magnitude: and this ſeemeth by all mankind to be conceived ſo inſeparable from a body, as when a man would diſtinguiſh a corporeall ſubſtance from a ſpirituall one (which is accounted indiviſible) he naturally pitcheth upon an apprehenſion of its having bulk, and being ſolid, tangible, and apt to make impreſsion upon our outward ſenſes; according to that expreſſion of Lucretius, who ſtudying Nature in a familiar and rationall manner telleth us, *Tangere enim & tangi, niſi corpus nulla poteſt res:* And therefore in our inquiry of Bodies, we will obſerve that plain methode which Nature teacheth us, and will begin with examining, *What Quantity is*, as being their

1. *Quantitie* is the firſt and moſt obvious affection of a Body.

first and primary affection; and that which maketh the things we treat of, be what we intend to signifie by the name of Body.

2. Words do not expresse things as they are in themselves, but onely as they are painted in the minds of men.

But because there is a great variety of apprehensions framed by learned men of the nature of *Quantity* (though indeed nothing can be more plain and simple then it is in it self) I conceive it will not be amisse, before we enter into the explication of it, to consider how the mysterie of discoursing and expresing our thoughts to one another by words (a prerogative belonging onely to man) is ordered and governed among us; that so we may avoid those rocks, which many and for the most part, such as think they spin the finest thrids, do suffer shipwrack against in their subtilest discourses. The most dangerous of all which, assuredly is when they confound the true and reall natures of things, with the conceptions they frame of them in their own minds. By which fundamentall miscarriage of their reasoning, they fall into great errours and absurdities: and whatsoever they build upon so ruinous a foundation, proveth but useless cobwebs or prodigious Chymeras. It is true, words serve to expresse things; but if you observe the matter well, you will perceive they do so, onely according to the pictures we make of them in our own thoughts, and not according as the things are in their proper natures. Which is very reasonable it should be so, since the soul, that giveth the names, hath nothing of the things in her but these notions: and knoweth not the things otherwise then by these notions; and therefore cannot give other names but such as must signifie the things by mediation of these notions. In the things, all that belongeth unto them is comprised under one entire Entity: but in us, there are framed as many severall distinct formall conceptions, as that one thing sheweth it self unto us with different faces. Every one of which conceptions seemeth to have for its object a distinct thing, because the conception it self is as much severed and distinguished from another conception or image, arising out of the very same thing that begot this, as it can be from any image painted in the understanding by an absolutely other thing.

3. The first errour that may arise from hence;

It will not be amisse to illustrate this matter by some familiar example. Imagine I have an apple in my hand: the same fruit worketh different effects upon my severall senses: my eye

telleth

telleth me it is green or red: my noſe that it hath a mellow ſent: my taſte that it is ſweet, and my hand that it is cold and weightie. My ſenſes thus affected, ſend meſſengers to my phantaſie with news of the diſcoveries they have made: and there, all of them make ſeverall and diſtinct pictures of what entereth by their doors. So that my Reaſon (which diſcourſeth upon what it findeth in my phantaſie) can conſider greenneſſe by it ſelf, or mellowneſſe, or ſweetneſſe, or coldneſſe, or any other quality whatſoever, ſingly and alone by it ſelf, without relation to any other that is painted in me by the ſame apple: in which, none of theſe have any diſtinction at all, but are one and the ſame ſubſtance of the apple, that maketh various and different impreſſions upon me, according to the various diſpoſitions of my ſeverall ſenſes: as hereafter we ſhall explicate at large. But in my mind, every one of theſe notions is a diſtinct picture by it ſelf, and is as much ſevered from any of the reſt ariſing from the ſame apple, as it would be from any impreſsion or image made in me, by a ſtone or any other ſubſtance whatſoever, that being entire in it ſelf and circumſcribed within its own circle, is abſolutely ſequeſtred from any communication with the other: ſo that what is but one entire thing in it ſelf, ſeemeth to be many diſtinct things in my underſtanding: whereby, if I be not very cautious, and in a manner wreſtle with the bent and inclination of my underſtanding (which is apt to referre the diſtinct and complete ſtamp it findeth within it ſelf, unto a diſtinct and complete originall character in the thing) I ſhall be in danger before I am aware, to give actuall Beings to the quantity, figure, colour, ſmell, taſt, and other accidents of the apple, each of them diſtinct one from another, as alſo from the ſubſtance which they clothe; becauſe I find the notions of them really diſtinguiſhed (as if they were different Entities) in my mind. And from thence I may inferre, there is no contradiction in nature to have the accidents really ſevered from one another, and to have them actually ſubſiſt without their ſubſtance: and ſuch other miſtaken ſubtilties, which ariſe out of our unwary conceiting that things are in their own natures after the ſame faſhion as we conſider them in our underſtanding.

which is a multiplying of things, where no ſuch multiplication is really found.

4. A second errour; the conceiving of many distinct things as really one thing.

And this course of the minds disguising and changing the impressions it receiveth from outward objects, into appearances quite differing from what the things are in their own reall natures; may be observed not onely in multiplying Entities where in truth there is but one: but also in a contrary manner, by comprising severall distinct things under one single notion; which if afterwards it be reflected back upon the things themselves, is the occasion of exceeding great errours, and entangleth one in unsuperable difficulties. As for example: Looking upon severall cubes or deyes, whereof one is of gold, another of lead, a third of ivory, a fourth of wood, a fifth of glasse, and what other matter you please; all these severall things agree together in my understanding, and are there comprehended under one single notion of a cube; which (like a painter that were to designe them onely in black and white) maketh one figure that representeth them all. Now if removing my consideration from this impression which the severall cubes make in my understanding, unto the cubes themselves, I shall unwarily suffer my self to pin this one notion upon every one of them, and accordingly conceive it to be really in them; it will of necessity fall out by this misapplying of my intellectuall notion to the reall things, that I must allow Existence to other entities, which never had nor can have any in nature.

From this conception, Plato's Idea's had their birth; for he finding in his understanding one universall notion that agreed exactly to every individuall of the same species of substance, which imprinted that notion in him; and conceiving that the picture of any thing must have an exact correspondence with the thing it representeth; and not considering that this was but an imperfect picture of the individuall that made it: he did thence conceive, there was actually in every individuall substance one universall Nature running through all of that species, which made them be what they were. And then considering that corporeity, quantity, and other accidents of matter, could not agree with this universall subsistent Nature, he denied all those of it: and so, abstracting from all materiality in his Idea's, and giving them a reall & actuall subsistence in nature, he made them like Angels, whose essences and formall reasons were to be

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the Essence and to give Exsistence unto corporeall individuals: and so each Idea was embodied in every individuall of its species. Unto which opinion ( and upon the same grounds ) Averroes did lean, in the particular of mens souls. Likewise Scotus finding in his understanding an universall notion springing from the impression that individuals make in it, will have a like universall in the thing it self, so determining universals (to use his own language and terms) to be *á parte rei*; and expressing the distinction they have from the rest of the thing, by the terms of *actu formaliter, sed non realiter*: and thereby maketh every individuall comprise an universall subsistent nature in it. Which inconvenience other modern Philosophers seeking to avoid, will not allow these universalls a reall and actuall subsistence; but will lend them onely a fictitious Being, so making them as they call them *Entia rationis*. But herein again they suffer themselves to be carried down the stream before they are aware by the understanding (which is apt to pin upon the objects, the notions it findeth within it self resulting from them ) and do consider an unity in the things which indeed is onely in the understanding.

5. Great care to be taken to avoid the errours which may arise from our manner of understanding things.

Therefore one of our greatest cares in the guidance of our discourse, and a continuall and sedulous caution therein, ought to be used in this particular, where every errour is a fundamentall one, and leadeth into inextricable labyrinths, and where that which is all our level to keep us upright and even ( our understanding ) is so apt, by reason of its own nature and manner of operation, to make us slide into mistaking and errour. And to summe up in short what this discourse aimeth at, we must narrowly take heed , lest reflecting upon the notions we have in our mind, we afterwards pin those aiery superstructures upon the materiall things themselves, that begot them; or frame a new conception of the nature of any thing by the negotiation of our understanding, upon those impressions which it self maketh in us: whereas we should acquiesce and be content with that naturall and plain notion, which springeth immediately and primarily from the thing it self: which when we do not, the more we seem to excell in subtilty, the further we go from reality and truth; like an arrow, which being wrong levelled at hand, falleth widest when shot in the strongest bow.

6. Two sorts of words to expresse our notions; the one common to all men, the other proper to scholars.

Now to come to another point that maketh to our present purpose. We may observe there are two sorts of language to expresse our notions by: The one belongeth in generall to all mankind, and the simplest person, that can but apprehend and speak sense, is as much judge of it as the greatest Doctour in the schools: and in this, the words expresse the things properly and plainly, according to the naturall conceptions that all people agree in making of them. The other sort of language is circled in with narrower bounds; and is understood onely by those that in a particular and expresse manner have been trained up unto it: and many of the words which are proper to it have been, by the authours of it, translated and wrested from the generall conceptions of the same words, by some metaphore, or similitude, or allusion, to serve their private turns. Without the first manner of expressing our notions, mankind could not live in society together, and converse with one another: whereas, the other hath no further extent, then among such persons as have agreed together to explicate and designe among themselves particular notions peculiar to their arts and affairs.

Of the first kind, are those tenne generall heads, which Aristotle calleth Predicaments: under which he (who was the most judicious orderer of notions, and directour of mens conceptions that ever lived) hath comprised whatsoever hath, or can have, a being in nature. For when any object occurreth to our thoughts, we either consider the essentiall and fundamentall Being of it; or we referre it to some species of Quantitie; or we discover some qualities in it; or we perceive that it doeth, or that it suffereth something; or we conceive it in some determinate place, or time, and the like. Of all which, every man living that enjoyeth but the use of reason findeth naturally within himself at the very first naming of them, a plain, complete, and satisfying notion; which is the same without any the least variation, in all mankind; unlesse it be in such, as have industruously, and by force, and with much labour, perplexed and depraved those primary and sincere impressions, which nature had freely made in them.

Of the second sort, are the particular words of art by which

which learned men use to expresse what they mean in Sciences; and the names of instruments, and of such things as belong to trades, and the like: as a sine, a tangent, an epicycle, a deferent, an axe, a trowell, and such others; the intelligence of which belongeth not to the generality of mankind; but onely to Geometricians, Astronomers, Carpenters, Masons, and such persons as converse familiarly and frequently with those things. To learn the true signification of such words, we must consult with those that have the knowledge and practise of them: as in like manner, to understand the other kind of plain language, we must observe how the words that compose it are apprehended, used, and applied by mankind in generall; and not receive into this examination the wrested or Metaphoricall senses of any learned men, who seek oftentimes (beyond any ground in nature) to frame a generall notion that may comprehend all the particular ones, which in any sense, proper or improper, may arise out of the use of one word.

7. Great errours arise by wresting words from their common meaning to expresse a more particular or studied notion.

And this is the cause of great errours in discourse; so great and important, as I cannot too much inculcate the caution requisite to the avoyding of this rock. Which that it may be the better apprehended, I will instance in one example of a most plain and easie conception wherein all mankind naturally agreeth, how the wresting it from its proper, genuine, and originall signification, leadeth one into strange absurdities; and yet they passe for subtill speculations. The notion of being in a place, is naturally the same in all men living: ask any simple artisan, Where such a man, such a house, such a tree, or such a thing is; and he will answer you in the very same manner as the learnedest Philosopher would do: he will tell you, the man you ask for, is in such a church, sitting in such a piew, and in such a corner of it; that the house you inquire after, is in such a street, and next to such two buildings on each side of it; that the tree you would find out, is in such a forest, upon such a hill, near such a fountain, and by such a bush; that the wine you would drink of, is in such a cellar, in such a part of it, and in such a cask. In conclusion, no man living that speaketh naturally and freely out of the notion he findeth clearly in his understanding, will give you

other anſwer to the queſtion of, *where a thing is*, then ſuch a one as plainly expreſſeth his conceit of being in place, to be no other, then a bodies being environed and incloſed by ſome one, or ſeverall others that are immediate unto it; as the place of a liquour, is the veſſell that containeth it; and the place of the veſſell, is ſuch a part of the chamber or houſe that it reſteth upon, together with the ambient aire; which hath a ſhare in making up the places of moſt things. And this being the anſwer, that every man whatſoever will readily give to this queſtion; and every asker being fully ſatisfied with it; we may ſafely conclude, That all their notions and conceptions of being in a place, are the ſame; and conſequenly, that it is the naturall and true one.

But then ſome others, conſidering that ſuch conditions as theſe will not agree unto other things, which they likewiſe conceit to be in a place (for they receive it as an axiome from their ſenſe, that whatſover is, muſt be ſomewhere, and whatſoever is no where, is not at all) they fall to caſting about how they may frame ſome common notion to comprehend all the ſeverall kinds of being in place, which they imagine in the things they diſcourſe of. If there were nothing but bodies to be ranked by them in the Predicament of Place, then that deſcription I have already ſet down would be allowed by them, as ſufficient. But ſince that ſpirits and ſpirituall things (as Angels, rationall ſouls, verities, ſciencies, arts, and the like) have a being in nature; and yet will not be compriſed in ſuch a kind of place as a body is contained in; they rack their thoughts to ſpeculate out ſome common notion of being in place, which may be common to theſe, as well as to bodies; like a common accident agreeing to diverſe ſubjects. And ſo in the end, they pitch upon an Entity, which they call an *Ubi*: and they conceit the nature and formall reaſon of that to be, the ranking of any thing in a place, when that Entity is thereunto affixed. And then they have no further difficulty, in ſettling an Angell, or any pure ſpirit, or immateriall eſſence, in a place as properly, and as completely, as if it were a corporeall ſubſtance. It is but aſſigning an Ubi to ſuch a ſpirit, and he is preſently riveted to what place you pleaſe: and by multiplying the Ubies,

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any individuall body unto which they are assigned, is at the same instant in as many distant places, as they allot it different Ubies: and if they assigne the same Ubi to severall bodies, so many severall ones as they assigne it unto will be in one and the same place: and not onely many bodies in one place, but even a whole bodie in an indivisible by a kind of Ubi that hath a power to resume all the extended parts and inclose them in a point of place. All which prodigious conceits and impossibilities in nature do spring out of their mistake in framing Metaphysicall and abstracted conceptions, insteed of contenting themselves with those plain, easie and primary notions, which nature stampeth alike in all men of common sense, and understanding. As who desireth to be further instructed in this particular, may perceive, if he take the pains to look over what M. White hath discoursed of *Place*, in the first of his Dialogues *De Mundo*. Unto which book I shall from time to time (according as I shall have occasion) referre my Reader in those subjects the Authour taketh upon him to prove; being confident that his Metaphysicall demonstrations there, are as firm as any Mathematicall ones (for Metaphysicall demonstrations have in themselves as much firmnesse, certainty and evidencie as they) and so will appear as evident as they, unto whosoever shall understand them throughly, and shall frame right conceptions of them: which (how plain soever they seem to be) is not the work of every pretender to learning.

## CHAP. II.

### *Of Quantitie.*

1. We must know the vulgar and common notion of Quantitie that we may understand the nature of it.

AMong those primary affections which occurre in the perusall of a body, *Quantitie* (as I have observed in the precedent chapter) is one, and in a manner the first and the root of all the rest. Therefore (according to the caution we have been so prolix in giving, because it is of so main importance) if we aim at right understanding the true nature of it, we must examine, what apprehension all kinds of people (that is, mankind in generall) maketh of it. By which proceeding, we do not make the ignorant multitude judge of that learning which groweth out of the consideration of Quantitie: but one-

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ly of the naturall notion which serveth learned men for a basis and foundation to build scientificall superstructures upon. For although sciencies be the works and structures of the understanding governed and levelled by the wary and strict rules of most ingenuous artificers, yet the ground upon which they are raised, are such plain notions of things, as naturally and without any art, do present themselves to every mans apprehension: without which for matter to work upon, those artificiall reflections would leave the understanding as unsatisfied, as a cook would the appetite by a dish upon which he should have exercised all his art in dressing it, but whose first substance were not meat of solid nutriment: it is the course market that must deliver him plain materialls to employ his cunning upon: And in like manner, it is the indisciplined multitude that must furnish learned men with naturall apprehensions and notions to exercise their wits about: which when they have, they may use and order and reflect upon them as they please: but they must first receive them in that plain and naked form, as mankind in generall pictureth them out in their imaginations.

And therefore the first work of scholars is to learn of the people, *Quem penes, arbitrium est & jus & norma loquendi*, what is the true meaning and signification of these primary names, and what notions they beget in the generality of mankind of the things they designe. Of the common people then we must enquire *What Quantity is:* and we shall soon be informed, if we but consider what answer any sensible man will make upon the sudden to a question whereof that is the subject: for such unstudied replies expresse sincerely the plain and naturall conceptions which they that make them have of the things they speak of. And this of Quantity is the plainest and the first that nature printeth in us, of all the things we see, feel, and converse withall; and that must serve for a ground unto all our other inquiries and reflections: for which cause we must be sure not to receive it wrested or disguised from its own nature.

2. Extension or divisibility is the common notion of Quantity.

If then any one be asked, What Quantitie there is in such a thing, or how great it is; he will presently in his understanding compare it with some other thing (equally known by both parties)

parties) that may serve for a measure unto it; and then answer, That it is as big as it, or twice as big, or not half so big, or the like: in fine, that it is bigger or lesser then another thing, or equall to it.

It is of main importance to have this point throughly and clearly understood; therefore it will not be amisse to turn it and view it a little more particularly. If you ask what quantity there is of such a parcell of cloth, how much wood in such a piece of timber, how much gold in such an ingot, how much wine in such a vessel, how much time was taken up in such an action? he that is to give you an account of them measureth them by ells by feet, by inches, by pounds, by ounces, by gallons, by pints, by dayes, by houres, and the like; and then telleth you, how many of those parts are in the whole that you enquire of. Which answer, every man living will at the instant, without study, make to this question; and with it, every man that shall ask will be fully appayed and satisfied: so that it is most evident, it fully expresseth the notions of them both, and of all mankind, in this particular.

Wherefore, when we consider that Quantity is nothing else, but the extension of a thing; and that this extension is expressed by a determinate number of lesser extensions of the same nature; (which lesser ones, are sooner and more easily apprehended then greater; because we are first acquainted and conversant with such; and our understanding graspeth, weigheth and discerneth such more steadily; and maketh an exacter judgement of them) and that such lesser ones are in the greater which they measure as parts in a whole; and that the whole by comprehending those parts, is a mere capacity to be divided into them; we conclude, That *Quantity* or *Bigneſſe* is nothing else but divisibility; and that a thing is big, by having a capacity to be divided, or (which is the same) to have parts made of it.

This is yet more evident (if more may be) in Discrete Quantity (that is, in *number*) then in continued Quantity, or extension. For if we consider any number whatsoever, we shall find the essence of it consisteth in a capacity of being resolved and divided into so many unities, as are contained in it; which are the parts of it. And this species of Quantity being simpler then the other, serveth for a rule to determine it by: as we may observe

observe in the familiar answers to questions of continued Quantity, which expresse by number the content of it: as when one delivereth the Quantity of a piece of ground, by such a number of furlongs, acres, perches, or the like.

3. Parts of Quantity are not actually in their whole.

But we must take heed of conceiving, that those parts, which we consider to discern the nature of Quantity, are actually and really in the *whole* of any continued one that containeth them. Ells, feet, inches, are no more reall Entities in the *whole* that is measured by them, and that maketh impressions of such notions in our understanding; then in our former example, colour, figure, mellowness, taste, and the like, are severall substances in the apple that affecteth our severall senses with such various impressions. It is but one *whole*, that may indeed be cut into so many severall parts: but those parts are not really there, till by division they are parcelled out: and then, the *whole* (out of which they are made) ceaseth to be any longer: and the parts succeed in lieu of it; and are every one of them a new *whole*.

This truth is evident out of the very definition we have gathered of Quantity. For since it is *divisibility* (that is, a bare capacity to division) it followeth, that it is not yet divided: and consequently, that those parts are not yet in it, which may be made of it; for division, is the making two or more things of one.

4. If parts were actually in their whole, Quantity would be composed of indivisibles.

But because this is a very great controversie in schools, and so important to be determined and settled, as without doing so, we shall be lyable to main errours in searching the nature and operations of bodies; and that the whole progresse of our discourse, will be uncertain and wavering, if this principle and foundation be not firmly laid; we must apply our selves, to bring some more particular and immediate proof of the verity of this assertion. Which we will do, by shewing the inconvenience, impossibility and contradiction, that the admittance of the other leadeth unto. For if we allow actuall parts to be distinguished in Quantity, it will follow that it is composed of points or indivisibles, which we shall prove to be impossible.

The first will appear thus: if Quantity were divided into all the parts into which it is divisible, it would be divided into indivisibles (for nothing divisible, and not divided, would remain in it) but it is distinguished into the same parts, into which

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it would be divided, if it were divided into all the parts into which it is divisible; therefore it is distinguished into indivisibles. The major proposition is evident to any man that hath eyes of understanding. The minor, is the confession or rather the position of the adversary, when he saith that all its parts are actually distinguished. The consequence cannot be calumniated, since that indivisibles, whether they be separated or joyned, are still but indivisibles; though that which is composed of them be divisible. It must then be granted that all the parts which are in Quantity, are indivisibles; which parts being actually in it, and the whole being composed of these parts onely, it followeth, that Quantity is composed and made of indivisibles.

If any should cavill at the supposition, and say, we stretch it further then they intend it, by taking *all* the parts to be distinguished; whereas they mean onely that there are parts actually in Quantity, abstracting from *all*: by reason that *all*, in this matter, would inferre an infinity, which to be actually in any created thing, they will allow to be impossible. Our answer will be, to represent unto them how this is barely said, without any ground or colour of reason, merely to evade the inconvenience that the argument driveth them unto. For if any parts be actually distinguished, why should not all be so? What prerogative have some that the others have not? And how came they by it? If they have their actuall distinction out of their nature of being parts, then all must enjoy it alike, and all be equally distinguished, as the supposition goeth: and they must all be indivisibles as we have proved. Besides to prevent the cavill upon the word *all*, we may change the expression of the Proposition into a negative: for if they admit (as they do) that there is no part in Quantity, but is distinguished as farre as it may be distinguished, then the same conclusion followeth with no lesse evidence; and all will prove indivisibles, as before.

5. Quantity cannot be composed of indivisibles.

But it is impossible that indivisibles should make Quantity; for if they should, it must be done either by a finite and determinate number, or by an infinite multitude of them. If you say by a finite; let us take (for example) three indivisibles, and by adding them together, let us suppose a line to be composed; whose extent being onely longitude, it is the first and simplest species of Quantity, and therefore whatsoever is divisible into parts,

parts, must be at the least a line. This line thus made, cannot be conceived to be divided into more parts then into three; since doing so you reduce it into the indivisibles that composed it. But Euclide hath demonstratively proved beyond all cavill (in the tenth proposition of his sixth book of Elements) that any line whatsoever may be divided into whatsoever number of parts; so that if this be a line, it must be divisible into a hundred or a thousand, or a million of parts: which being impossible in a line, that being divided into three parts onely, every one of those three is incapable of further division: it is evident, that neither a line, nor any Quantity whatsoever, is composed or made of a determinate number of indivisibles.

And since that this capacity of being divisible into infinite parts, is a property belonging to all extension (for Euclides demonstration is universall) we must needs confesse that it is the nature of indivisibles, when they are joyned together, to be drowned in one another, for otherwise there would result a kind of extension out of them, which would not have that property; contrary to what Euclide hath demonstrated. And from hence it followeth that Quantity cannot be composed of an infinite multitude of such indivisibles; for if this be the nature of indivisibles, though you put never so great a number of them together, they will still drown themselves all in one indivisible point. For what difference can their being infinite, bring to them, of such force as to destroy their essence and property? If you but consider how the essentiall composition of any multitude whatsoever, is made by the continuall addition of unities, till that number arise; it is evident in our case that the infinity of indivisibles must also arise, out of the continued addition of still one indivisible to the indivisibles presupposed: then let us apprehend a finite number of indivisibles, which (according as we have proved) do make no extension, but are all of them drowned in the first; and observing how the progresse unto an infinite multitude, goeth on by the steps of one and one, added still to this presupposed number: we shall see that every indivisible added, and consequently the whole infinity, will be drowned in the first number, as that was in the first indivisible.

Which will be yet plainer, if we consider that the nature of extension

extension requireth that one part be not in the same place, where the other is: then if this extension be composed of indivisibles, let us take two points of place in which this extension is, and inquire whether the indivisibles that are in each one of these points, be finite or infinite. If it be answered that they are finite, then the finite indivisibles in these two points make an extension; which we have proved impossible. But if they be said to be infinite; then infinite indivisibles are drowned in one point, and consequently have not the force to make extension. Thus then it remaineth firmly established, *That Quantity is not composed of indivisibles* (neither finite, nor infinite ones) and consequently, *That parts are not actually in it.*

6. An objection to prove that parts are actually in Quantity; with a declaration of the mistake from whence it proceedeth.

Yet before we leave this point, although we have already been somewhat long about it, I conceive it will not be tedious, if we be yet a little longer, and bend our discourse to remove a difficulty that even Sense it self seemeth to object unto us. For doth not our eye evidently inform us, there are fingers, hands, arms, legs, feet, toes and variety of other parts in a mans body? These are actually in him, and seem to be distinct things in him, so evidently, that we cannot perswaded, but that we see, and feel the distinction between them; for every one of them hath a particular power of actuall working and doing what belongeth unto its nature to do: each finger is really there; the hand is different from the foot; the leg from the arm; and so of the rest. Are not these parts then actually and really in a mans body? And is not each of them as really distinguished from any other?

This appeareth at the first sight to be an insuperable objection, because of the confirmation and evidence that sense seemeth to give it. But looking nearly into the matter, we shall find that the difficulty ariseth not from what sense informeth us of; but from our wrong applying the conditions of our notions unto the things that make impressions upon our sense. Sense judgeth not which is a finger, which is a hand, or which is a foot. The notions agreeing to these words, as well as the words themselves, are productions of the understanding: which considering severall impressions made upon the sense by the same thing as it hath a virtue and power to severall operations, frameth severall notions of it: as in our former example, it doth of

of colour, figure, taſt, and the like, in an apple. For as theſe are not different bodies or ſubſtances, diſtinguiſhed one from another; but are the ſame one entire thing, working ſeverally upon the ſenſes, and that accordingly, maketh theſe different pictures in the mind; which are there as much diſtinguiſhed, as if they were pictures of different ſubſtances. So, the parts which are conſidered in Quantity, are not divers things: but are onely a virtue or power to be divers things: which virtue, making ſeverall impreſſions upon the ſenſes, occaſioneth ſeverall notions in the underſtanding: and the underſtanding is ſo much the more prone to conceive thoſe parts as diſtinct things, by how much Quantity is nearer to be diſtinct things, then the qualities of the apple are. For Quantity, is a poſſibility to be made diſtinct things by diviſion: whereas the others, are but a virtue to do diſtinct things. And yet (as we have touched above) nothing can be more manifeſt, then that if Quantity be diviſibility (which is a poſſibility, that many things may be made of it) theſe parts are not yet divers things. So that, if (for example) a rod be laid before us, and half of it be hid from our ſight, and the other half appear; it is not one part or thing that ſheweth it ſelf, and another part or thing that doth not ſhew it ſelf: but it is the ſame rod or thing, which ſheweth it ſelf according to the poſſibility of being one new thing, but doth not ſhew it ſelf according to the poſſibility of being the other of the two things it may be made by diviſion. Which example if it be well conſidered will make it much more eaſily ſink into us, that a hand, or eye, or foot, is not a diſtinct thing by it ſelf; but that it is the man, according as he hath a certain virtue or power in him to diſtinct operations. For if you ſever any of theſe parts from the whole body; the hand can no more hold; nor the eye ſee; nor the foot walk; which are the powers that eſſentially conſtitute them to be what they are: and therefore they are no longer a hand, an eye, or a foot.

7. The ſolution of the former objection: and that Senſe cannot diſcern whether one part be diſtinguiſhed from another, or no.

Now then to come to the objection; let us examine how farre Senſe may be allowed to be judge in this difficulty: and we ſhall find, that Senſe cannot determine any one part in a body: for if it could, it would preciſely tell, where that part beginneth or endeth: but it being agreed upon, that it beginneth and endeth in indiviſibles; it is certain, that Senſe cannot determine of them.

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If then ſenſe cannot determine any one part, how ſhall it ſee that it is diſtinguiſhed from all other parts? Again; conſidering that all that whereof ſenſe is capable is diviſible, it ſtill telleth us, that in all it ſeeth, there are more parts then one: and therefore it cannot diſcern, nor inform us of any that is one alone: nor knoweth what it is to be one; for it never could diſcern it: but what is many, is many *ones* and cannot be known, by that, which knoweth not, what it is to be one: and conſequently ſenſe cannot tell us, that there are many. Wherefore it is evident, that we may not rely upon ſenſe for this queſtion. And as for reaſon, ſhe hath already given her verdict.

So that nothing remaineth but to ſhew, why we talk as we do, in ordinary diſcourſe, of many parts: and that what we ſay in that kind, is true, notwithſtanding the unity of the thing. Which will appear plainly, if we conſider that our underſtanding hath a cuſtome for the better diſcerning of things, to impoſe upon a thing as it is under one notion, the excluſion of it ſelf as it is under other notions. And this is evident unto all ſchollars, when the mark of excluſion is expreſſely put: as when they ſpeak of a white thing, adding the reduplication, *as it is white*: which excludeth all other conſiderations of that thing beſides the whiteneſſe of it: but when it cometh under ſome particular name of the thing, it may deceive thoſe that are not cunning: though indeed, moſt men diſcover it in ſuch names as we call abſtracted; as humanity, animality, and the like. But it eaſily deceiveth when it cometh in concrete names; as it doth in the name of *Part* in generall, or in the names of particular parts; as a hand, an eye, an inch, an elle, and others of the like nature: for as you ſee that a part excludeth both the notion of the whole, and of the remaining parts; ſo doth a hand, an eye, an elle, exclude all the reſt of that thing whereof the hand is a hand, and the elle is an elle, and ſo forth. Now then, as every man ſeeth evidently that it cannot be ſaid, the wall as it is white is plaſter or ſtone: no more can it be ſaid, that the hand of a man is his foot; becauſe the word *hand* ſignifieth as much in it ſelf, as if the man were taken, by reduplication, to be the man as he is hand, or as he hath the power of holding. So likewiſe, in the rod we ſpoke of before; it cannot be ſaid that the part ſeen is the part unſeen; becauſe the part

seen, signifieth the rod as it is a possibilitie to be made by division such a thing, as it appeareth to the sight. And thus it is clear how the difficulty of this point, ariseth out of the wrongfull applying the conditions of our notions, and of names, to the objects and things which we know: whereof we gave warning in the beginning. Chap. 1. §. 2. 3

8. An enumeration of the severall species of Quantity, which confirmeth that the essence of it is divisibilitie.

After which there remaineth no more to be said of this subject, but to enumerate the severall species of Quantitie, according to that division which Logitians for more facilitie of discourse have made of it. Namely, these six, magnitudine, place, motion, time, number, and weight. Of which, the two first are permanent, and lie still exposed to the pleasure of whosoever hath a mind to take a survey of them. Which he may do by measuring what parts they are divisible into; how many ells, feet, inches, a thing is long broad or deep; how great a place is; whether it be not bigger or lesser then such another; and by such considerations as these; which do all agree in this, that they expresse the essence of those two species of Quantitie, to consist in a capacity of being divided into parts.

The two next; motion and time; though they be of a fleeting propriety, yet it is evident that in regard of their originall and essentiall nature, they are nothing else but a like divisibilitie into parts; which is measured by passing over so great or so little distance; and by years, dayes, hours, minutes, and the like. Number we also see is of the same nature; for it is divisible into so many determinate parts, and is measured by unities, or by lesser numbers so or so often contained in a proposed greater. And the like is evident of weight, which is divisible into pounds, ounces, drammes, or grains; and by them is measured. So that looking over all the severall species of Quantitie; it is evident, our definition of it is a true one, and expresseth fully the essence of it, when we say it is *divisibilitie*, or a capacitie to be divided into parts; and that no other notion whatsoever, besides this, reacheth the nature of it.

CHAP.

## CHAP. III.

### *Of Raritie and Densitie.*

I Intend in this Chapter to look as farre as I can into the nature and causes of the two first differences of bodies which follow out of Quantitie as it concurreth with substance to make a body: for, the discovery of them, and of the various proportions of them among themselves, will be a great and important step in the journey we are going. But the scarcitie of our language is such, in subjects removed from ordinary conversation, (though in others, I thin k none is more copious or expressive) as affordeth us not apt words of our own to expresse significantly such notions as I must busie my self about in this discourse. Therefore I will presume to borrow them from the Latine school, where there is much ado about them. I would expresse the difference between bodies, that under the same measures and outward bulk, have a greater thinnesse and expansion, or thickneſse and soliditie, one then another; which terms, (or any I can find in English) do not signifie fully those affections of Quantitie that I intend here to declare: therefore I will do it under the names of Raritie and Densitie; the true meaning of which will appear by what we shall hereafter say.

1 What is meane by Rarity and Densitie.

It is evident unto us, that there are different sorts of bodies, of which though you take equall quantities in one regard, yet they will be unequall in another. Their magnitudes may be the same, but their weights will be different; or contrariwise, their weights being equall, their outward measures will not be so. Take a pinte of aire; and weigh it against a pinte of water, and you will see the ballance of the last go down amain: but if you drive out the aire by filling the pinte with lead, the other pinte in which the water is, will rise again as fast: which if you poure out, and fill that pinte with quicksilver, you will perceive the lead to be much lighter: and again, you will find a pinte of gold heavier then so much Mercurie. And in like manner, if you take away of the heavie bodies till they agree in weight with the lighter, they will take up & fill different proportions, and parts of the measure that shall contain them.

2. It is evident that some bodies are rare and others dense; though obscure, how they are such.

But from whence this effect ariseth, is the difficultie that we

would lay open. Our measures tell us their quantities are equall, and reason assureth us, there cannot be two bodies in one and the same place; therefore when we see that a pinte of one thing outweigheth a pinte of another that is thinner, we must conclude that there is more body compacted together in the heavie thing then in the light: for else how could so little of a solide or dense thing be stretched out to take up so great room, as we see in a basin of water that being rarified into smoke or aire, filleth a whole chamber? and again, shrink back into so little room, as when it returneth into water, or is contracted into ice? But how this comprehension of more body in equall room is effected, doth not a little trouble Philosophers.

3. A brief enumeration of the severall properties belonging to the rare and dense bodies.

To find a way that may carry us through these difficulties that arise out of the Rarity and Densitie of bodies, let us do as Astronomers when they enquire the motions of the Spheres and Planets: they take all the Phenomena or severall appearances of them to our eyes; and then attribute to them such orbs, courses, and periods, as may square and fit with every one of them; and by supposing them, they can exactly calculate all that will ever after happen to them in their motions. So let us take into our consideration the chief properties of rare and dense bodies, and then cast with our selves to find out an hypothesis or supposition (if it be possible) that may agree with them all.

First, it seemeth unto us that dense bodies have their parts more close and compacted then others have that are more rare and subtil. Secondly, they are more heavy then rare ones. Again, the rare are more easily divided then the dense bodies: for water, oyl, milk, honey and such like substances will not onely yield easily to any harder thing that shall make its way through them; but they are so apt to division and to lose their continuity, that their own weights will overcome and break it: whereas in iron, gold, marble, and such dense bodies, a much greater weight and force is necessary to work that effect. And indeed if we look well into it, we shall find that the rarer things are as divisible in a lesser Quantity, as the more dense are in a greater: and the same force will break the rarer thing into more and lesser parts, then it will an equall one that is more dense. Take a stick of light wood of such a bigneſſe

nesse that being a foot long, you may break it with your hands, and another of the same bignesse, but of a more heavie and compacted wood, and you shall not break it, though it be two foot long: and with equall force you may break a loaf of bread into more and lesse parts, then a lump of lead that is of the same bignesse. Which also will resist more to the division of fire (the subtilleſt divider that is) then so much water will; for the little atomes of fire (which we shall discourse of hereafter) will pierce and cut out in the water, almost as little parts as themselves, and mingling themselves with them they will flie away together, and so convert the whole body of water into subtile smoke: whereas the same Agent, after long working upon lead, will bring it into no lesse parts then small grains of dust, which it calcineth it into. And gold, that is more dense then lead, resisteth peremptorily all the dividing power of fire; and will not at all be reduced into a calx or lime, by such operation as reduced lead into it.

So that remembring how the nature of Quantity is Divisibility; and considering that rare things are more divisible then dense ones; we must needs acknowledge that the nature of quantity is some way more perfectly in things that are rare, then in those that are dense. On the other side, more compacted and dense things, may haply seem to some to have more Quantity then those that are rare; and that it is but shrunk together: which may be stretched out and driven into much greater dimensions then the Quantity of rare things, taking the quantities of each of them equall in outward appearance. As gold may be beaten into much more and thinner leaf, then an equall bulk of silver or lead. A wax candle will burn longer with equall light, then a tallow candle of the same bignesse; and consequently, be converted into a greater quantity of fire and aire. Oyl will make much more flame then spirit of wine, that is farre rarer then it.

4. The opinion of those Philosophers declared, who put rarity to consist in an actuall division of a Body into little parts.

These and such like considerations have much perplexed Philosophers, and have driven them into diverse thoughts to find out the reasons of them. Some observing that the dividing of a body into little parts, maketh it lesse apt to descend, then when it is in greater; have believed the whole cause of lightnesse and rarity to be derived from division. As for example, they find

find that lead cut into little pieces, will not go down so fast in water, as when it is in bulk: and it may be reduced into so small atomes, that it will for some space swimme upon the water like dust of wood.

Which assumtion is proved by the great Galileus; unto whose excellent wit and admirable industry the world is beholding, not onely for his wonderfull discoveries made in the heavens, but also for his accurate and learned declaring of those very things that lie under our feet. He, about the 90. page of his first Dialogue of motion, doth clearly demonstrate how any reall medium must of necessity resist more the descent of a little piece of lead, or any other weighty matter, then it would a greater piece: and the resistence will be greater and greater, as the pieces are lesser and lesser. So that as the pieces are made lesse, they will in the same medium sink the slower; and do seem to have acquired a new nature of lightnesse by the diminution: not onely of having lesse weight in them then they had; as half an ounce is lesse then a whole ounce: but also of having in themselves a lesse proportion of weight to their bulk then they had; as a pound of cork is in regard of its magnitude lighter then a pound of lead: so as they conclude, that the thing whose continued parts are the lesser, is in its own nature the lighter and the rarer; and other things whose continued parts are greater, they be heavier and denser.

5 The former opinion rejected, and the ground of their errour discovered.

But this discourse reacheth not home: for by it the weight of any body being discovered by the proportion it hath to the medium in which it descendeth, it must ever suppose a body lighter then it self in which it may sink and go to the bottome. Now of that lighter body, I enquire, what maketh it be so; and you must answer by what you have concluded, that it is lighter then the other, because the parts of it are lesse, and more severed from one another: for if they be as close together, their division availeth them nothing, since things sticking fast together, do work as if they were but one, and so a pound of lead though it be filed into small dust, if it be compacted hard together, will sink as fast as if it were in one bulk.

Now then allowing the little parts to be separated, I ask, what other body filleth up the spaces between those little parts of the medium in which your heavy body descended? For if the

the parts of water are more severed then the parts of lead, there must be some other substance to keep the parts of it asunder: let us suppose this to be aire: and I ask, Whether an equall part of aire be as heavie as so much water? or whether it be not? If you say, it is; then the compound of water and aire must be as heavie as lead; seeing that their parts one with an other are as much compacted as the parts of lead are. For there is no difference whether those bodies, whose little parts are compacted together, be of the same substance, or of divers, or whether the one be divided into smaller parts then the other, or no, (so they be of equall weights) in regard of making the whole equally heavie: as you may experience, if you mingle pin-dust with a sand of equall weight, though it be beaten into farre smaller divisions then the pin-dust, and put them in a bag together.

But if you say, that aire is not so heavy as water; it must be, because every part of aire hath again its parts more severed by some other body, then the parts of water are severed by aire. And then I make the same instance of that body which severeth the parts of aire. And so at the last (since there cannot actually be an infinite processe of bodies one lighter then another) you must come to one, whose little parts filling the pores and spaces between the parts of the others, have no spaces in themselves to be filled up.

But assoon as you acknowledge such a body to be lighter and rarer then all the rest, you contradict and destroy all you said before. For by reason of its having no pores, it followeth by your rule, that the little parts of it must be as heavy, if not heavier, then the little parts of the same bigneſſe of that bodie whose pores it filleth; and consequently it is proved by the experience we alledged of pin-dust mingled with sand, that the little parts of it cannot by their mingling with the parts of the body in which it is immediately contained, make that lighter then it would be if these little parts were not mingled with it. Nor would both their parts mingled with the body which immediately containeth them, make that body lighter. And so proceeding on in the same sort through all the mingled bodies, till you come to the last, that is immediately mingled with water; you will make water nothing the lighter, for being mingled with all these; and by consequence it should be as heavie and as dense as lead.

Now that which deceived the authours of this opinion, was that they had not a right intelligence of the causes which made little parts of bodies ( naturally heavie ) descend slowly, in regard of the velocitie of greater parts of the same bodies descending : the doctrine of which we intend to deliver hereafter.

6. The opinion of those Philosophers related, who put rarity to consist in the mixtion of vacuity among bodies.

Others therefore perceiving this rule to fall short, have indeavoured to piece it out by the mixtion of vacuitie among bodies ; believing it is that which maketh one rarer then another. Which mixtion they do not put alwayes immediate to the main body they consider : but if it have other rarer and lighter bodies mingled with it, they conceive this mixtion immmediate onely to the rarest, or lightest. As for example ; a crystall being lighter and consequently rarer then a diamond, they will not say that there is more vacuity in a crystall then in a diamond; but that the pores of a crystall are greater, and that consequently there is more aire in a crystall to fill the pores of it, then is in a diamond ; and the vacuities are in the aire, which abounding in a crystall, more then in a diamond, maketh that lighter and rarer then this, by the more vacuities that are in the greater Quantitie of aire which is mingled with it.

But against this supposition, a powerfull adversary is urged: for Aristotle, in his 4. book of Physicks, hath demonstrated that there can be no motion in vacuity. It is true, they indeavour to evade his demonstration ( as not reaching home to their supposition ) by acknowledging it to be an evident one in such a vacuity as he there speaketh of ; which he supposed to be so great a one that a bodie may swimme in it as in an ocean, and not touch or be near any other body : whereas this opinion excludeth all such vast inanitie, and admitteth no vacuities but so little ones as no body whatsoever can come unto but will be bigger then they ; and consequently, must on some side or other touch the corporeall parts which those vacuities divide; for they are the separations of the least parts that are, or can be, actually divided from one another : which parts must of necessitie touch one another on some side ; or else they could not hang together to compose one substance; and therefore, the dividing vacuities, must be lesse then the divided parts. And thus, no bodie will ever be in danger of floating up and down without touching any thing : which is the difficultie that Aristotle chiefly impugneth.

I confesse I should be very glad that this supposition might serve our turn, and save the Phenomena that appear among bodies, through their varietie of Raritie and Densitie: which if it might be, then would I straight go on to the inquiring after what followed out of this ground, as Astronomers (to use our former similitude) do calculate the future appearances of the celestiall bodies out of those motions and orbes they assigne unto the heavens. For as this apprehension of vacuitie in bodies is very easie and intelligible: so the other (which I conceive to be the truth of the case) is exceedingly abstracted, and one of the most difficult points in all the Metaphysicks: and therefore I would (if it were possible) avoid touching upon it in this discourse, which I desire should be as plain and easie, and as much removed from scholastick terms, as may be.

7. The opinion of vacuities refuted.

But indeed, the inconveniences that follow out of this supposition of vacuities, are so great, as it is impossible by any means to slide them over. As for example; let us borrow of Galileus the proportion of weight between water and aire. He sheweth us how the one is 400. times heavier then the other. And Marinus Ghetaldus teacheth us that gold is 19. times heavier then water: so that gold must be 7600 times heavier then aire. Now then considering that nothing in a body can weigh, but the solid parts of it; it followeth, that the proportion of the parts of gold in a sphere of an inch diameter, is to the parts of aire of a like dimension as 7600 is to one. Therefore in aire it self the vacuities that are supposed in it, will be to the solid parts of it in the same proportion as 7600 to one. Indeed, the proportion of difference will be greater: for even in gold many vacuities must be admitted, as appeareth by the heating of it which sheweth that in every the least part it is exceeding porous. But according to this rate, without pressing the inconvenience any further; the aire will by this reckoning appear to be like a net, whose holes and distances, are to the lines and thrids, in the proportion of 7600 to one; and so, would be lyable to have little parts of its body swimme in those greater vacuities; contrary to what they strive to avoid. Which would be exceedingly more, if we found on the one side any bodies heavier and denser then gold, & that were so solide as to exclude all vacuities; & on the other side should ballance them with such bodies

Dialog. 1. del. Movim. pag. 81.

Archimed. Promot.

bodies as are lighter and rarer then aire; as fire is, and as some will have the *æther* to be. But already the disproportion is so great, and the vacuity so strangely exceedeth the body in which it is, as were too great an absurdity to be admitted.

And besides, it would destroy all motion of small bodies in the aire, if it be true (as Aristotle hath demonstrated in the fourth book of his Physicks) that motion cannot be made but among bodies, and not *in vacuo*.

Again, if rarity were made by vacuity, rare bodies could not be gathered together, without losing their rarity and becoming dense. The contrary of which, we learn by constant experience; as when the smith and glassemender drive their white and fury fires, (as they term them;) when aire piercеth most in the sharp wind; and generally we see that more of the same kind of rare bodies, in lesse place, worketh most efficaciously according to the nature that resulteth out of that degree of rarity. Which argueth, that every little part is as rare as it was before (for else it would lose the virtue of working according to that nature;) but that by their being crowded together, they exclude all other bodies that before did mediate between the little parts of their main body; and so, more parts being gotten together in the same place then formerly there were, they work more forcibly.

Thirdly, if such vacuities were the cause of rarity, it would follow, that fluide bodies being rarer then solid ones, they would be of themselves standing, like nets or cobwebs: whereas contrariwise, we see their natures are to run together, and to fill up every little creek and corner: which effect, following out of the very nature of the things themselves; must needs exclude vacuities out of that nature.

And lastly, if it be true (as we have shewed in the last Chapter) that there are no actuall parts in Quantity; it followeth of necessity, that all Quantity must of it self be one; as Metaphysicks teach us: and then, no distance can be admitted between one Quantity and another.

And truly, if I understand Aristotle right, he hath perfectly demonstrated, that no vacuity is possible in nature; neither great nor little: and consequently, the whole machine raised upon that supposition, must be ruinous. His argument is to this purpose:

purpose: What is nothing, cannot have parts: but vacuum is nothing (becauſe as the adverſaries conceive it, vacuum is the want of a corporeall ſubſtance in an encloſing body, within whoſe ſides nothing is, whereas a certain body might be contained within them, as if in a pail or bowl of a gallon, there were neither milk, nor water, nor aire, nor any other body whatſoever) therefore, vacuum cannot have parts. Yet thoſe who admit it do put it expreſly for a ſpace; which doth eſſentially include parts. And thus they put two contradictories, nothing and parts, that is, parts and no parts; or ſomething and nothing; in the ſame propoſition. And this, I conceive to be abſolutely unavoidable.

8. Rarity and Denſity conſiſt in the ſeverall proportions, which Quantity hath to its ſubſtance.

For theſe reaſons therefore, I muſt entreat my readers favour, that he will allow me to touch upon metaphyſicks a little more then I deſire or intended: but it ſhall be no otherwiſe, then as is ſaid of the dogs by the river Nilus ſide; who being thirſty, lap haſtily of the water, onely to ſerve their neceſſity as they run along the ſhore. Thus then; remembring how we determined that Quantity is Diviſibility: it followeth, that if beſides Quantity there be a ſubſtance or thing which is diviſible; that thing, if it be conſtinguiſhed from its Quantity or Diviſibility, muſt of it ſelf be indiviſible: or (to ſpeak more properly) it muſt be, not diviſible. Put then ſuch ſubſtance to be capable of the Quantity of the whole world or univerſe; and conſequently, you put it of it ſelf indifferent to all, and to any part of Quantity: for in it, by reaſon of the negation of Diviſibility, there is no variety of parts, whereof one ſhould be the ſubject of one part of Quantity, or another of another; or that one ſhould be a capacity of more, another of leſſe.

This then being ſo, we have the ground of more or leſſe proportion between ſubſtance and quantity: for if the whole quantity of the univerſe be put into it, the proportion of Quantity to the capacity of that ſubſtance, will be greater then if but half that quantity were imbibed in the ſame ſubſtance. And becauſe proportion changeth on both ſides by the ſingle change of onely one ſide: it followeth, that in the latter, the proportion of that ſubſtance to its Quantity, is greater; and that in the former, it is leſſe; howbeit the ſubſtance in it ſelf be indiviſible.

What

What we have said thus in abstract, will sink more easily into us if we apply it to some particular bodies here among us, in which we see a difference of Rarity and Density; as to aire, water, gold, or the like; and examine if the effects that happen to them, do follow out of this disproportion between substance and Quantity. For example, let us conceive that all the Quantity of the world were in one uniform substance, then the whole universe would be in one and the same degree of Rarity and Density: let that degree, be the degree of water; it will then follow, that in what part soever there happeneth to be a change from this degree, that part will not have that proportion of quantity to its substance, which the quantity of the whole world had to the presupposed uniform substance. But if it happeneth to have the degree of rarity which is in the aire, it will then have more quantity in proportion to its substance, then would be due unto it according to the presupposed proportion of the quantity of the universe to the foresaid uniform substance; which in this case is as it were the standard to try all other proportions by. And contrariwise, if it happeneth to have the degree of Density which is found in earth or in gold; then it will have lesse quantity in proportion to its substance, then would be due unto it according to the foresaid proportion, or common standard.

Now to proceed from hence, with examining the effects which result out of this compounding of Quantity with substance, we may first consider, that the definitions which Aristotle hath given us of Rarity and Density, are the same we drive at: he telleth us, that that body is rare whose quantity is more, and its substance lesse; that, contrariwise dense, where the substance is more and the quantity lesse. Now if we look into the proprieties of the bodies we have named, or of any others, we shall see them all follow clearly out of these definitions. For first, that one is more diffused, another more compacted; such diffusion and compaction seem to be the very natures of Rarity and Density, supposing them to be such as we have defined them to be; seeing that, substance is more diffused by having more parts, or by being in more parts; and is more compacted by the contrary. And then, that rare bodies are more divisible then dense ones, you see is coincident into the same conceit with their diffusion and compaction. And from hence again it follo-

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loweth, that they are more easily divided in great, and likewise, that they are by the force of naturall Agents divisible into lesser parts: for both these (that is, facility of being divided, and easie divisibility into lesser parts) are contained in being more divisible; or in more enjoying the effect of quantity, which is divisibility. From this again followeth, that in rare bodies there is lesse resistance to the motion of another body through it, then in dense ones; and therefore a like force passeth more easily through the one, then through the other. Again; rare bodies are more penetrative and active then dense ones; because being (by their overproportion of quantity) easily divisible into small parts, they can run into every little pore, and so incorporate themselves better into other bodies, then more dense ones can. Light bodies likewise must be rarer, because most divisible, if other circumstances concurre equally.

Thus you see decyphered unto your hand, the first division of bodies flowing from Quantity as it is ordained to substance for the composition of a bodie: for since the definition of a body is, *A thing which hath parts*; and quantity is that, *by which it hath parts*; and the first propriety of quantity is, *to be bigger* or *lesse*; and consequently the first differences of having parts, are to have bigger or lesse, more or fewer; what division of a body can be more simple, more plain, or more immediate, then to divide it by its *Quantity* as making it have bigger or lesse, more or fewer parts in proportion to its substance?

Neither can I justly be blamed for touching thus on Metaphysicks, to explicate the nature of these two kinds of bodies: for Metaphysicks being the science above Physicks, it belongeth unto her to declare the principles of Physicks: of which, these we have now in hand, are the very first step. But much more, if we consider that the composition of quantity with substance, is purely Metaphysicall; we must necessarily allow the inquiry into the nature of Rarity and Density, to be wholly Metaphysicall; seeing that the essence of Rarity and Density standeth in the proportion of quantity to substance; if we believe Aristotle, (the greatest master that ever was, of finding out definitions and notions) and trust to the uncontroulable reasons we have brought in the precedent discourse.

This explication of Rarity and Density, by the composition 9.
of

All must admit in Physicall bodies, a Metaphysicall composition.

of substance with quantitie, may peradventure give little satisfaction unto such as are not used to raise their thoughts above Physicall and naturall speculations; who are apt to conceive there is no other composition or resolution, but such as our senses shew us in compounding and dividing of bodies according to quantative parts. Now this obligeth us to shew that such a kind of composition and division as this, must necessarily be allowed of, even in that course of doctrine which seems most contrary to ours. To which purpose, let us suppose that the position of Democritus or of Epicurus is true; to wit, that the originall composition of all bodies, is out of very little ones of various figures; all of them indivisible, not Mathematically, but Physically: and that this infinite number of indivisibles, doth float in an immense ocean of vacuum or imaginary space. In this position, let any man who conceiveth their grounds may be maintained, explicate how one of these little bodies is moved. For taking two parts of vacuum, in which this body successively is; it is cleare, that really, and not onely in my understanding, it is a difference in the said body to be now here now there: wherefore when the body is gone thither, the notion of being here is no more in the body; and consequently is divided from the body. And therefore when the body was here, there was a composition between the body and its being here; which seeing it cannot be betwixt two parts of Quantity, must of necessity be such a kind of composition, as we put between quantity and substance. And certainly, let men wrack their brains never so much, they will never be able to shew how motion is made, without some such composition and division, upon what grounds soever they proceed.

And if then they tell us, that they understand not how there can be a divisibility between substance and quantity; we may reply, that to such a divisibility two things are required; first, that the notions of substance and quantity be different; secondly, that the one of them may be changed without the other. As for the first, it is most evident we make an absolute distinction between their two notions; both when we say that Socrates was bigger a man then a boy; and when we conceive that milk or water whiles it boyleth, or wine whiles it worketh, so as they run over the vessels they are in, are greater, and

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possesse more place then when they were cool and quiet, and filled not the vessel to the brim. For howsoever witty explications may seem to evade, that the same thing is now greater now lesser; yet it cannot be avoided, but that ordinary men who look not into Philosophy, do both conceive it to be so, and in their familiar discourse expresse it so; which they could not do, if they had not different notions of the substance, and of the quantity of the thing they speak of. And though we had no such evidences, the very names and definitions of them would put it beyond strife: all men calling substance, a thing; quantitie, bignesse: and referring a thing to *Being*; as who would say, that which is: but bignesse to some other of like nature, unto which it is compared; as, that it is half as big, twice as big, or the like.

This then being unavoidable, that the notions are distinguished; there remaineth no difficulty but onely in the second, namely that the one may be changed, and the other not. Which reason and demonstration do convince, as we have shewed. Wherefore if any shall yet further reply, that they do not understand how such change is made; we shall answer, by asking them whether they know how the change of being sometimes here sometimes there is made by locall motion in vacuum, without a change in the body moved. Which question if they cannot satisfie, they must either deny that there is any locall motion in vacuum; or else admit a change in quantity without a change in substance; for this latter is as evidently true, as they suppose the former to be; though the manner how they are effected be alike obscure in both, and the reason of the obscurity the same in both.

With which we will conclude the present Chapter; adding onely this note: That if all Physicall things and naturall changes do proceed out of the constitution of rare and dense bodies in this manner as we do put them, (as the work we have in hand intendeth to shew) then, so manifold effects will so convince the truth of this doctrine which we have declared, that there can remain no doubt of it: neither can there be any of the divisibility of quantity from substance; without which this doctrine cannot consist. For it cannot be understood, how there is a greater proportion of quantitie then of substance;

stance; or contrariwise, of substance then of quantity; if there be not a reall divisibility between quantity and substance. And much lesse can it be conceived, that the same thing hath at one time a greater proportion of quantity, and at another time a lesse, if the greater or lesser proportion be not separable from it; that is, if there be not a divisibility betwixt it and substance, as well as there are different notions of them. Which to prove by the proper principles belonging to this matter, would require us to make a greater inrode into the very bowels of Metaphysicks, and to take a larger circuite then is fitting either for the subject, or for the intended brevity of this Treatise.

## CHAP. IIII.

### *Of the foure first qualities: and of the foure Elements.*

1. The notions of density and rarity have a latitude capable of infinite variety.

THe subject of our discourse hitherto hath been three simple notions; Quantity, Rarity, and Density. Now it shall be to enquire if by compounding these with gravitie or weight (which is one of the species of Quantity above mentioned, and of which I shall speak at large hereafter) we may beget any further qualities, and so produce the foure first bodies called Elements. In imitation of Logitians, who by compounding such propositions as of themselves are evident to mans nature assoon as they are proposed, do bring forth new knowledges: which thrids they still entermix and weave together, till they grow into a fair piece. And thus the sciences they so much labour for, and that have so great an extent, do result out of few and simple notions in their beginnings.

But before we fall to mingling and comparing them together, I think it will not be amisse to set down and determine what kind of things we mean by rare, and what by dense; to the end that when the names are agreed upon, we may slip into no errour by mistaking them. So then although there be severall considerations, in regard of which, rarity and density may be differently attributed to bodies: yet because mans discerning them, to be able to discourse accordingly of them, is the principall respect for which their denominations are to be allotted them:

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we may with reason call those things dense, wherein a man findeth a sensible difficultie to part them; and those rare, where the resistance is imperceptible.

And unto these two notions of rarity and density, we must allow a great latitude, farre from consisting in an indivisible state; for seeing that rarefaction maketh a lesser bodie equall to a bigger; and that all inequalitie betwixt two bodies, hath the conditions of a bodie; it followeth that the excesse of one bodie over an other, consisteth of infinite parts into which it might be divided: and consequently, that what is rarified, passeth as many degrees as the inequalitie or excesse hath parts. And the same law being in condensation, both dense and rare things must be acknowledged to be capable of infinite varietie, and diversity of states in regard of more and lesse in the same kind.

2. How moistnesse and drynesse are begotten in dense bodies.

These things being premised; and calling to mind that it is the nature of density to make the parts of a dense thing compact, and stick together, and be hardly divisible; and on the contrary side, that it is the nature of rarity, to diffuse and extend a rare thing, and to prepare and approch it to division, according to the proportion of the degree of rarity which it hath; and that weight doth abound where there is excesse of densitie, and is very little or none in excesse of rarity: we may now begin in our imagination to put these qualities into the scales one against another, to see what effects they produce in bodies. And first, let us weigh gravity against densitie or sticking together of parts: which sticking or compactednesse being naturall to densitie, requireth some excesse of gravitie in proportion to the density, or some other outward violence, to break it. If then in a dense body the gravity overcome the density, and do make the parts of it break asunder, it will draw them downwards towards the center that gravity tendeth unto, and will never let them rest till they come thither, unlesse some impediment meet them by the way and stop their journey: so that such a body will, as near as possibly it can, lie in a perfect spherical figure in respect of the center; and the parts of it will be changed and altered, and thurst on any side that is the ready way thither; so that by the force of gravity working upon it, it will run as farre as it meeteth with nothing to hinder it from

attaining this spherical superficies. Wherefore such bodies, for the most part, have no settled outside of their own; but do receive their figure and limits from such lets as hinder them from attaining to that spherical nesse they aim at.

Now Aristotle (whose definitions, are in these matters generally received, as fully expressing the notions of mankind) telleth us, and our own experience confirmeth it, that we use to call those things *moist*, which run in such sort as we have here set down; and that we term those things *dry*, which have a consistence within themselves; and which to injoy a determinate figure, do not require the stop or hinderance of another body to limit and circle them in: which will be the nature of those that have a greater proportion of density in respect of their gravity.

And thus, out of the comparison of densitie with weight, we have found two more qualities then we yet had met withall, namely wetnesse and dryenesse. For although a body be dense, (which of its own nature, singly considered, would preserve the continuity of its parts, as making the body hardly divisible; whereby it would be dry) yet if the gravity that worketh upon it, be in proportion greater then the densitie; it will sever the parts of it, and make them run to the center, and so become fluide and moist: though not in the eminentest degree that may be of fluidity and moisture; by reason that if the like overproportion of gravity happen in a rare body, it will there more powerfully work its effect, then it can in a dense body; because a rare body will more easily obey, and yield to the gravitie that mastereth it, then a dense one will; and consequently, will be more fluide and moist then it.

3. How moistnesse and dryenesse are begotten in rare bodies.

Now on the other side, in weighing rarity against gravity; if it happen that the rarity overcome the gravity, then the gravity will not change the figure of a body so proportioned, but what figure it hath from its proper naturall causes, the same will still remain with it: and consequently, such a body will have terms of its own, and will not require an ambient body to limit, and circle it in: which nature, we call dry.

But if the proportion of the gravity be the greater and do overcome the rarity; then, by how much the rarity is greater, so much the more will the gravity force it, to apply it self equal-

ly

ly and on all sides to the center: and such a body will the more easily receive its figure from another, and will be lesse able to consist of it self: which properties, we attribute to wetnesse or moisture. So that it appeareth, how the qualities of wet and dry, which first we found in things that were dense, are also common to that nature of bodies, which we term rare.

And thus, by our first inquiry after what kind of bodies do result out of the compounding of rarity and densitie with gravity, we discover foure different sorts: some dense ones that are dry, and others likewise dense that are moist: then again, some rare ones that are likewise moist, & other rare ones that are dry.

4. Heat is a properrie of rare bodies, and cold of dense ones.

But we must not rest here: let us proceed a little further, to search what other properties these foure kinds of bodies will have; which we shall best discover, if we apply them severally to some other compounded body (of which nature, are all those we converse with or see) and then consider the effects which these do work upon it. To beginne with that, which we said is so excessively rare that gravity hath no power over it. If we look upon the multitude of little parts it may be divided into, whereof every one will subsist by it self (for we have already proved it dry) and then suppose them to be moved with force and strength against the body we apply them to: it must necessarily follow, that they will forcibly get into the porousnesse of it, and passe with violence between part and part, and of necessity separate the parts of that thing one from another; as a knife or wedge doth a solide substance, by having their thinnest parts pressed into it: so that if in the compounded thing, some parts be more weighty, others more light, (as of necessitie there must be) the heaviest will all fall lowest, the lightest will fly uppermost, and those which are of a mean nature between the two extremes, will remain in middle. In summe, by this action of an extreme rare body upon a compounded one, all the parts of one kind that were in the compounded one, will be gathered into one place; and those of divers kinds into divers places: which is the notion whereby Aristotle hath expressed the nature of heat; and is an effect, which daily experience in burning and boyling, teacheth us to proceed from heat. And therefore we cannot doubt, but that such extreme rare bodies are as well hot as dry.

On the other side, if a dense thing be applyed to a compound, it will (because it is weighty) presse it together: and if that application be continued on all sides, so that no part of the body that is pressed be free from the siege of the dense body that presseth it, it will form it into a narrower room, and keep in the parts of it, not permitting any of them to slip out. So that what things soever it findeth within its power to master, be they light or heavy, or of what contrary natures soever, it compresseth them as much as it can, and draweth them into a lesse compasse, and holdeth them strongly together, making them stick fast to one another. Which effect, Aristotle took for the proper notion of cold; & therefore gave for definition of the nature of it, *that it gathereth things of divers natures:* and experience sheweth us in freesing, and all great coolings, that this effect proceedeth from cold.

5. Of the two dense bodies, the lesse dense is more cold: but of the two rare ones, the lesse rare is lesse hot.

But if we examine which of the two sorts of dense bodies (the fluide or the consistant) is most efficacious in this operation; we shall find that the lesse dense one is more capable of being applyed round about the body it shall besiege; and therefore will stop closer every little hole of it, and will more easily send subtile parts into every little vein of it; and by consequence, shrink it up together and coagulate, and constringe it more strongly, then a body can that is extremely dense; which by reason of its great density, and the stubbornesse of its parts, cannot so easily bend and plie them to work this effect. And therefore, a body that is moderately dense is colder then another that is so in excesse; seeing that cold is an active or working power, and that which is lesse dense doth excell in working.

On the contrary side, rare bodies being hot, because their subtile parts environing a compounded body will sink into the pores of it, and to their power separate its parts; it followeth that those wherein the gravity overcometh the rariry, are lesse hot then such others as are in the extremity, and higheſt excesse of rarity: both, because the former are not able to pierce so little parts of the resisting dense body, as extreme rare ones are; and likewise, because they more easily take ply by the obstacle of the solide ones they meet with, then these do.

So,

So that out of this discourse we gather, that of such bodies that differ precisely by the proportion of Rarity and Density; those which are extremely rare, are in the excesse of heat, and are dry withall: that weighty rare bodies are extremely humide, and meanly hot: that fluide dense bodies are moist, though not in such excesse as rare ones that are so; but are coldest of any: and lastly, that extreme dense bodies are lesse cold then fluide dense ones, and that they are dry.

6. The extreme dense body is more dry, then the extreme rare one.

But whether the extreme dense bodies be more or lesse dry then such as are extremely rare, remaineth yet to be decided. Which we shall easily do, if we but reflect that it is density which maketh a thing hard to be devided, and that rarity maketh it easie: for a facility to yield unto division, is nothing else but a pliableness in the thing that is to be divided, whereby it easily receiveth the figure, which the thing that divideth it doth cast it into. Now this pliableness belongeth more to rare then to dense things: and accordingly, we see fire bend more easily, by the concameration of an oven, then a stone can be reduced into due figure by hewing. And therefore, since dryness is a quality that maketh those bodies wherein it reigneth, to conserve themselves in their own figure and limits, and to resist the receiving of any from another body; it is manifest that those are driest, wherein these effects are most seen; which is, in dense bodies: and consequently, excesse of dryness must be allotted unto them, to keep company with their moderate coldness.

7. There are but foure simple bodies: and these are rightly named Elements.

Thus we see that the number of Elements assigned by Aristotle is truly and exactly determined by him; and that there can be neither more nor lesse of them; and that their qualities are rightly allotted to them: which to settle more firmly in our minds, it will not be misse-spent time to summe up in short the effect of what we have hitherto said to bring us unto this conclusion. First, we shewed that a body is made, and constituted a body by quantity. Next, that the first division of bodies is into rare and dense ones; as differing onely by having more and lesse quantity. And lastly, that the conjunction of gravity with these two, breedeth two other sorts of combinations: each of which is also twofold; the first sort, concerning rarity; out of which ariseth one extremely hot and moderately dry, and another

other extremely humide and moderately hot: the second sort, concerning density; out of which, is produced one that is extremely cold and moderately wet, and another extremely dry and moderately cold. And these are the combinations whereby are constituted fire, aire, water, and earth.

So that we have thus, the proper notions of the foure Elements; and have both them and their qualities driven up and resolved into their most simple principles: which are, the notions of *Quantity*, and of the two most simple differences of quantative things, *Rarity* and *Density*. Beyond which, mans wit cannot penetrate; nor can his wishes aim at more in this particular: seeing he hath attained to the knowledge of what they are, and of what maketh them be so, and that it is impossible they should be otherwise: and this, by the most simple and first principles, which enter into the composition of their nature. Out of which it is evident, that these foure bodies are *Elements*: since they cannot be resolved into any others, by way of physicall composition; themselves being constituted by the most simple differences of a body. And again, all other bodies whatsoever must of necessity be resolved into them, for the same reason; because no bodies can be exempt from the first differencies of a body. Since then, we mean by the name of an Element, *a body not composed of any former bodies, and of which all other bodies are composed*, we may rest satisfied that these are rightly so named.

8. The Authour doth not determine whether every element doth comprehend under its name one onely lowest species, or many: nor whether any of them be found pure.

But whether every one of these foure elements, do comprehend under its name one onely lowest species or many (as, whether there be one onely species of fire, or severall; and the like of the rest) we intend not here to determine. Yet we note, that there is a great latitude in every kind; seeing that, Rarity and Density (as we have said before) are as divisible as quantity. Which latitudes, in the bodies we converse withall, are so limited that what maketh it self and other things be seen (as being accompanied by light) is called fire. What admitteth the illuminative action of fire, and is not seen, is called aire. What admitteth the same action, and is seen (in the rank of Elements) is called water. And what through the density of it admitteth not that action, but absolutely reflecteth it, is called earth.

And

And out of all we said of these foure Elements, it is manifest there cannot be a fifth: as is to be seen at large in every Aristotelian Philosopher that writeth of this matter. I am not ignorant that there are sundry objections used to be made, both against these notions of the first qualities, and against the division of the Elements: but because they, and their solutions, are to be found in every ordinary Philosopher; and that they be not of any great difficulty; and that the handling them, is too particular for the designe of this discourse, and would make it too prolix; I referre the Reader to seek them, for his satisfaction, in those authours that treat physicks professedly, and have delivered a compleat body of Philosophy.

And I will end this Chapter with advertising him (lest I should be misunderstood) that though my disquisition here hath pitched upon the foure bodies of fire, aire, water, and earth; yet it is not my intention to affirm, that those which we ordinary call so, and do fall dayly within our use, are such as I have here expressed them: or that these Philosophicall ones (which arise purely out of the combination of the first qualities) have their residence or consistence in great bulks, in any places of the world, be they never so remote: as fire, in the hollow of the moons orb; water, in the bottome of the sea; aire, above the clouds; and earth below the mines. But these notions are onely to serve for certain Idea's of Elements; by which, the foure named bodies, and the compounds of them, may be tryed and receive their doom of more or lesse pure and approaching to the nature from whence they have their denomination. And yet I will not denie, but that such perfect Elements may be found in some very little quantities, in mixed bodies: and the greatest abundance of them, in these foure known bodies that we call in ordinary practise, by the names of the pure ones: for they are least compounded, and approach most to the simplenesse of the Elements. But to determine absolutely their existence, or not existence, either in bulk or in little parts; dependeth of the manner of action among bodies: which as yet we have not meddled with.

## CHAP. V.

### *Of the operations of the Elements in generall. And of their activities compared with one another.*

1. The first operation of the Elements is division, out of which resulteth locall motion.

HAving by our former discourse inquired out what degrees, and proportions of rarity and density compounded with gravity, are necessary for the production of the Elements, & first qualities; whose combinations, frame the Elements: our next consideration in that orderly progresse we have proposed unto our selves in this treatise (wherein our aim is, to follow successively the steps, which nature hath printed out unto us) will be to examine the operations of the Elements, by which they work upon one another. To which end, let us propose to our selves a rare and a dense body encountring one another by the impulse of some exterior agent. In this case, it is evident, that since rarity implyeth a greater proportion of quantity, and quantity is nothing but divisibility, rare bodies must needs be more divisible then dense ones: and consequently, when two such bodies are pressed one against another; the rare body not being able to resist division so strongly, as the dense one is; and being not permitted to retire back, by reason of the extern violence impelling it against the dense body; it followeth, that the parts of the rare body must be severed, to let the dense one come between them: and so the rare body becometh divided, and the dense body the divider. And by this we see that the notions of divider and divisible do immediately follow rare and dense bodies; and do so much the more properly agree unto them, as they exceed in the qualities of Rarity and Density.

Likewise, we are to observe in our case, that the dense or dividing body must necessarily cut and enter further and further into the rare or divided body; and so the sides of it be joyned successively to new and new parts of the rare body that giveth way unto it, and forsake others it parteth from. Now the rare body being in a determinate situation of the universe, (which we call *being in a place*, and is a necessary condition belonging to all particular bodies) and the dense body coming to be within the rare body, whereas formerly it was not so: it followeth, that it loseth the place it had, and gaineth another. This effect, is that which we call locall motion.

And

And thus we see, by explicating the manner of this action, that locall motion is nothing else but the change of that respect or relation, which the body moved hath to the rest of the universe, following out of Division: and the name of locall motion, formally signifieth onely the mutation of a respect to other extrinsecall bodies, subsequent to that division. And this is so evident and agreeable to the notions that all mankind (who, as we have said, is judge and master of language) naturally frameth of place, as I wonder much why any will labour to give other artificiall and intricate doctrine of this that in it self is so plain and clear. What need is there to introduce an imaginary space (or with Joannes Grammaticus, a subsistent quantity) that must run through all the world; and then entayl to every body an aiery entity, an unconceiveable mood, an unintelligible Ubi, that by an intrinsecall relation to such a part of the imaginary space, must thereunto pin and fasten the body it is in? It must needs be a ruinous Philosophy that is grounded upon such a contradiction, as is the allotting of parts unto that, which the authours themselves (upon the matter) acknowledge to be merely nothing; and upon so weak a shift (to deliver them from the inconveniencies that in their course of doctrine other circumstances bring them unto) as is the voluntary creating of new imaginary Entities in things, without any ground in nature for them. Learned men should expresse the advantage and subtility of their wits, by penetrating further into nature, then the vulgar; not by vexing and wresting it from its own course. They should refine and carry higher, not contradict and destroy the notions of mankind, in those things that it is the competent judge of: as it undoubtedly is of those primary notions which Aristotle hath ranked under ten heads: which (as we have touched before) every body can conceive in grosse: and the work of scholars is to explicate them in particular; and not to make the vulgar believe they are mistaken, in framing those apprehensions that nature taught them.

2. What place is; both notionally and really.

Out of that which hath been hitherto resolved it is manifest, that place really, and abstracting from the operation of the understanding, is nothing else but the inward superficies of a body that compasseth and immediately containeth another. Which ordina-

ordinarily being of a rare body that doth not shew it self unto us (namely, the aire) is for the most part unknown by us. But because nothing can make impression upon our mind, and cause us to give it a name otherwise then by being known: therefore our understanding to make a complete notion, must adde something else to this fleeting and unremarkable superficies that may bring it unto our acquaintance. And for this end we may consider further, that as this superficies hath in it self, to the body enclosed in it gaineth a certain determinate respect unto the stable and immoveable bodies that environ it. As for example, we understand such a tree to be in such a place by having such and such respects to such a hill near it, or to such a house that standeth by it, or to such a river that runneth under it, or to such an immoveable point of the heaven that from the sunnes rising in the equinox is called East, and such like. To which purpose, it importeth not whether these that we call immoveable bodies and points be truly so, or do but seem so to mankind. For man talking of things according to the notions he frameth of them in his mind (speech being nothing else but an expression to an other man, of the images he hath within himself) and his notions being made according to the seeming of the things, he must needs make the same notions, whether the things be truly so in themselves, or but seem to be so, when that seeming or appearance is alwayes constantly the same.

3. Locall motion is that division whereby a body changeth its place.

Now then when one body dividing another, getteth a new immediate clothing; and consequently new respects to the stable and immoveable bodies (or seeming such) that environ it; we do vary in our selves the notion we first had of that thing; conceiving it now accompanied with other circumstances and other respects then formerly it had. Which notion we expresse by saying, it hath changed its place, and is now no longer where it was at the first. And this change of place we call *Locall motion:* to wit, the departing of a body from that hollow superficies which inclosed it; and its changing unto an other, whereby it gaineth new respects to those parts of the world that have, or in some sort may seem to have, immobility and fixed stableness. So as hence it is evident that the substance of locall motion consisteth in division; and that the alteration of Locality followeth division; in such sort as becoming like or unlike of one wall

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to another, followeth the action whereby one of them becometh white.

And therefore in nature we are not to seek for any entity or speciall cause of applying the moved body to a place as place, (which is but a respect consequent to the effect of division) but onely to consider what reall and physicall action uniteth it to that other body, which is called its place, and truly serveth for that effect. And consequently, they who think they have discovered a notable subtilty by bringing in an Entitie to unite a body to its place, have strained beyond their strength, and have grasped but a shadow. which will appear yet more evident, if they but mark well how nothing is divisible but what of it self (abstracting from division) is one. For the nature of division is *the making of many*; which implyeth, that what is to be divided must of necessity be not *many* before it be divided. Now quantity being the subject of division, it is evident that purely of it self and without any force or adjoyned helps, it must needs be one, wheresoever some outward agent doth not introduce multiplicity upon it. And whensoever other things work upon quantity as quantity, it is not the nature and power of their operation to produce unity in it and make it one; for it is already one: but contrariwise, the immediate necessary effect that floweth from them in this case, is to make one quantity many, according to the circumstances that accompany the divider, and that which is to be divided. And therefore, although we may seek causes why some one thing sticketh faster together then some other, yet to ask absolutely why a body sticketh together, were prejudiciall to the nature of quantity; whose essence is to have parts sticking together, or rather to have such unity, as without it all divisibility must be excluded.

4. The nature of quantity of it self is sufficient to unite a body to its place.

Out of which discourse it followeth, that in locall motion we are to look onely for a cause or power to divide, but not for any to unite. For the very nature of quantity uniteth any two parts that are indistant from one another, without needing any other cement to glew them together: as we see the parts of water and all liquid substances, do presently unite themselves to other parts of like bodies when they meet with them, and to solid bodies if they chance to be next unto them. And therefore it is vain to trouble our heads with Unions and imagina-

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ry Moods to unite a body to the place it is in, when their own nature maketh them one as soon as they are immediate to each other. And accordingly if when we see a boul move, we would examine the causes of that motion, we must consider the quantity of aire or water it maketh to break from the parts next unto it, to give place unto it self: and not speculate upon an intrinsecall relation from the body to a certain part of the imaginary space they will have to run through all things. And by ballancing that quantity of aire or water which it divideth, we may arrive to make an estimate of what force the boul needeth to have for its motion.

5. All operations amongst bodies, are either local motion, or such as follow out of locall motion.

Thus having declared that the locality of motion is but an extrinsecall denomination, and no reality in the thing moved; we may now cast an eye upon a vast consequence that may be deduced out of what we have hitherto said. For if we consider the nature of a body, that is, that a body is a body by quantity; and that the formall notion of quantity is nothing else but divisibility; and that the adequate act of divisibility is division: it is evident there can be no other operation upon quantity, nor (by consequence) among bodies, but must either be such division as we have here explicated, or what must necessarily follow out of such division. And division (as we have even now explicated) being locall motion; it is evident, that all operations among bodies are either locall motion, or such as follow out of locall motion. Which conclusion, howsoever unexpected, and may at the first hearing appear a Paradox, will nevertheless by the ensuing work receive such evidence as it cannot be doubted of; and that not onely by force of argumentation and by necessitie of notions (as is already deduced) but also by experience, and by declaration of particulars as they shall occurre.

6. Earth compared to water in activity.

But now to apply what we have said to our proposed subject: it is obvious to every man, that seeing the divider is the agent in division and in locall motion; and that dense bodies are by their nature dividers; the earth must in that regard be the most active among the elements, since it is the most dense of them all. But this seemeth to be against the common judgement of all the searchers of nature, who unanimously agree that fire is the most active element. As also it seemeth to impugne what we

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our selves have determined, when we said, there were two active qualities, heat and cold, whereof the first was in its greatest excesse in fire, and the latter in water.

To reconcile these, we are to consider that the action of cold in its greatest height is composed of two parts; the one is a kind of pressing, and the other is penetration which requireth applicability. Of which two the former ariseth out of density, but the latter out of moderation of density, as I have declared in the precedent Chapter. Wherefore the former will exceed more §. 6. in earth, though the whole be more eminent in water. For though considering onely the force of moving (which is a more simple and abstracted notion, then the determination and particularization of the Elements, and is precedent to it) therein earth hath a precedency over water: yet taking the action as it is determined to be the action of a particular Element, and as it concurreth to the composition or dissolution of mixed bodies; in that consideration (which is the chief work of Elements, and requireth an intime application of the Agents) water hath the principality and excesse over earth.

7. The manner whereby fire getteth into fewel, proveth that it exceedeth earth in activity.

As for fire it is more active then either of them; as it will appear clearly if we consider, how when fire is applyed to fewell, and the violence of blowing is added to its own motion; it incorporateth it self with the fewell, and in a small time converteth a great part of it into its own nature, and shattereth the rest into smoke and ashes. All which proceedeth from the exceeding smalnesse and dryenesse of the parts of fire; which being moved with violence against the fewell, and thronging in multitudes upon it; they easily pierce the porous substance of it, like so many extreme sharp needles.

And that the force of fire is as great and greater then of earth, we may gather out of our former discourse; where having resolved that density is the virtue by which a body is moved and doth cut the medium; and again considering that celerity of motion, is a kind of densitie, (as we shall by and by declare) it is evident, that since blowing must of necessity presse violently and with a rapid motion, the parts of fire against the fewel, and so condense them exceedingly there, (both by their celerity, and by bringing very many parts together there;) it must needs

needs also give them activity and virtue to pierce the body they are beaten against.

Now, that celerity is a kind of density, will appear by comparing their natures. For if we consider that a dense body may be dilated so as to possesse and fill the place of a rare body that exceeded it in bignesse; and by that dilatation, may be divided into as many and as great parts as the rare body was divisible into; we may conceive that the substance of those parts, was by a secret power of nature folded up in that little extension in which it was before. And even so, if we reflect upon two rivers of equall channels and depths, whereof the one goeth swifter then the other; and determine a certain length of each channell, and a common measure of time: we shall see that in the same measure of time, there passeth a greater bulk of water in the designed part of the channel of the swifter stream, then in the designed part of the slower, though those parts be equall.

Neither doth it import, that in velocity we take a part of time, whereas in density it seemeth that an instant is sufficient; and consequently, there would be no proportion between them. For knowing Philosophers do all agree that there are no instants in time, and that the apprehension of them proceedeth merely from the manner of our understanding. And as for parts in time, there cannot be assumed any so little, in which the comparison is not true: and so in this regard, it is absolutely good.

And if the Reader have difficulty at the disparity of the things which are pressed together in density and in celerity; for that in density there is onely substance, and in celerity there is also quantity, crowded up with the substance; he will soon receive satisfaction, when he shall consider that this disparity is to the advantage of what we say, and maketh the nature of density more perfect in celerity, and consequently more powerfull in fire then in earth. Besides, if there were no disparity, it would not be a distinct species of density, but the very same.

8. The same is proved by the manner, whereby fire cometh out of fewell and worketh upon other bodies.

By what we have spoken above, it appeareth how fire getteth into fewell; now let us consider how it cometh out: for the activity of that fierce body will not let it lie still and rest, as long as it hath so many enemies round about it to rouse it up. We see then that as soon as it hath incorporated it self with the fewell,

fewell and is grown maſter of it by introducing into it ſo many of its own parts, ( like ſo many ſouldiers, into an enemies town ) they break out again on every ſide with as much violence as they came in. For by reaſon of the former reſiſtance of the fewell; their continuall ſtreaming of new parts upon it, and one overtaking another there where their journey was ſtopped, ( all which is encreaſed by the blowing ) doth ſo exceedingly condenſe them into a narrower room then their nature affecteth, that as ſoon as they get liberty, and grow maſters of the fewell, ( which at the firſt was their priſon ) they enlarge their place, and conſequently come out and flie abroad; ever ayming right forwards from the point where they begin their journey: for the violence wherewith they ſeek to extend themſelves into a larger room, when they have liberty to do ſo; will admit no motion but the ſhorteſt, which is, by a ſtraight line.

So that if in our phantaſie, we frame an image of a round body all of fire; we muſt withall preſently conceive, that the flame proceeding from it, would diffuſe it ſelf every way indifferently in ſtraight lines; in ſuch ſort, that the ſource ſerving for the center, there would be round about it an huge ſphere of fire and of light; unleſſe ſome accidentall and extern cauſe ſhould determine its motion more to one part then to another. Which compaſſe, becauſe it is round, and hath the figure of a ſphere, is by Philoſophers termed the ſphere of its activity.

So that it is evident, that the moſt ſimple and primary motion of fire, is a flux in a direct line from the center of it, to its circumference, taking the fewell for its center: as alſo, that when, it is beaten againſt a harder body, it may be able to deſtroy it, although that body be in its own nature more denſe then fire. For the body againſt which it preſſeth, either hath pores, or hath none, ( as, the Elements have none: ) if it hath pores; then the fire, by reaſon of the violent motion of the impellent, driveth out the little bodies which fill up thoſe pores, and ſucceeding in their room, and being multiplyed there, cauſeth thoſe effects which in our diſcourſe of the Elements we aſſigned to heat. But if it have no pores; it will be either rare or denſe: if it be rare; then, in caſe that the force of the impellent be greater

greater then the resistance of the rare body, it will force the fire to divide the rare body. But if it be dense; as, some atome of earth; then, though at the first it cannot divide it; yet by length of time and by continuall beating upon it, it may come to wear off some part of it, the force of the impellent by little and little bending the atome of the earth, by driving a continuall stream of a lesser part of fire, against some determate part of the atome. By which word *Atome*, no body will imagine we intend to expresse a perfect indivisible, but onely, the least sort of naturall bodies.

## CHAP. VI.

### *Of Light: what it is.*

1. In what sense the Authour rejecteth qualities.

HAving said thus much of fire; the near relation that is between it and light, inviteth us in the next place to bend our eyes to that which useth to dazell theirs who look unwarily upon it. Certainly, as among all the sensible qualities, it is the principall; so among all corporeall things, it seemeth to aim righteſt at a spirituall nature, and to come neareſt unto it. And by some hath been judged to be spirituall; if our eyes be capable to see spirits. No meaner man then Aristotle leadeth the dance to hold light a quality, and mainly to deny it any bodily subsistence. And there hath followed him no fewer, then almost all the world ever since. And the question importeth no lesse, then the whole doctrine of qualities; for admit light to be a body, and hardly any man will hold up his hand in defence of any other quality: but if it be a quality; then all others come in by parity and for company.

But before we go any further, it will not be amisse to expresse what we mean when we reject qualities; and how, in some sense, we are content to admit them. According to that description that Philosophers ordinarily do make of them, (and especially the modern) we can by no means give way unto them. I confesse ingenuously, I understand not what they mean by them; and I confident, that neither do they. For the very notion, that their first words seem to expresse of them, they contradict again, before they make an end of describing what they are. They will have them to be reall

*Entities*

*Entities* or *Things*, distinct from the bodies they accompany: and yet, they deny them a subsistence or self-being; saying they do but inhere in their subject, which supporteth them; or which is all one, that their being is a dependence of a subject.

If they will reflect upon what they say, and make their thoughts and their words agree; they will find, that the first part of their description maketh them compleat substances; which afterwards, in words they flatly deny: and it is impossible to reconcile these two meanings. A reall Entity or thing must necessarily have an *Existence* or *Being* of its own: which they allow them. And whatsoever hath so, becometh a substance: for it subsisteth by its own Existence; or (to say plainer) is what it is by its own Being; and needeth not the existence of another thing to give it a *Being*. And then presently to say that it doth not subsist of it self; or that it requireth the subsistence of a substance, to make it *Be*; is a pure contradiction to the former.

This ariseth from a wrong notion they make to themselves of substance, existence and subsistence: and from their not consulting sufficiently with their own thoughts, as well as studying in books. They meet there with different terms; by help of which, they keep themselves from contradiction in words, but not in effect. If the terms were rightly conceived, and notions duely fitted to them, (which requireth deep meditation upon the things themselves, and a brain free from all inclination to siding, or affection to opinions for the authours sakes, before they be well understood and examined) many of those disputes would fall to the ground, in which oftentimes both sides lose themselves, and the question, before they come to an end. They are in the dark before they are aware: and then they make a noise, onely with terms; which like too heavy weapons that they cannot weild, do carry their strokes beyond their aim. Of such nature are the qualites and moods, that some modern Philosophers have so subtilised upon. And in that sense, we utterly denie them: which being a question appertaining to Metaphysicks, it belongeth not to our present purpose to ingage our selves further in it.

But, as they are ordinarily understood in common conver- 2.

In what sense the Authour doth admit of qualities.

sation, we allow them. And our work is but to explicate and shew the particulars in retail, of what men naturally speak in grosse. For that serveth their turn to know what one another meaneth: whereas, it belongeth onely unto a Philosopher, to examine the causes of things. Others are content with the effects: and they speak truly and properly when they designe them. As for example: when they say that fire burneth by a quality of heat that it hath, or that a deye is square by the quality of a cubicall figure that is in it; they speak as they should do. But if others will take occasion upon this, to let their understanding give a *Being* unto these qualities, distinct from the substances in which they conceive them; there they misse. If we consider the same man hungry, or thirsty, or weary, or sleepy, or standing, or sitting; the understanding presently maketh within it self reall things of sleep, hunger, thirst, wearinesse, standing, and sitting. Whereas indeed, they are but different affections or situations of the same body. And therefore we must beware of applying these notions of our mind, to the things as they are in themselves: as much as we must, of conceiving those parts to be actually in a continued quantity, whereof we can frame actually distinct notions in our understanding. But as, when ordinary men say, that a yard containeth three feet; it is true in this sense, that three feet may be made of it; but that whiles it is a yard, it is but one quantity or thing, and not three things: so, they who make profession to examine rigorously the meaning of words, must explicate in what sense it is true that heat and figure (our former examples) are qualities: for such we grant them to be; and in no wise do contradict the common manner of speech; which entereth not into the Philosophicall nature of them.

We say then, that qualities are nothing else but the proprieties, or particularities wherein one thing differeth from another. And therefore Logicians, call substantiall differencies, substantiall qualities: and say, they are predicated in *Quale quid*. But the Predicament of *Quality* is ordered by Aristotle to conclude in it those differences of things, which are neither substantiall nor quantitative, and yet are intrinsecall and absolute. And so that which the understanding calleth heat, and maketh a notion

notion of, diſtinct from the notion of the fire from whence it iſſueth to burn the wood that is near it; is nothing elſe, in the fire, but the very ſubſtance of it in ſuch a degree of rarity; or a continuall ſtream of parts iſſuing out of the main ſtock of the ſame fire, that entreth into the wood, and by the rarity of it maketh its way through every little part, and divideth them. All which actions are compriſed by the underſtanding under one notion of burning: and the power, (which is fire it ſelf) to do theſe actions, under one notion of the quality of heat: though burning in effect, and explicated Philoſophically, be nothing elſe but the continuance of thoſe materiall motions we have even now deſcribed. In like manner, the cubicall figure of a deye, is nothing elſe but the very body of the deye it ſelf, limited by other bodies from being extended beyond thoſe dimenſions it hath: and ſo the quality of figure or ſquareneſſe, which in common ſpeech is ſaid to be in it; is truly, the ſubſtance it ſelf, under ſuch a conſideration as is expreſſed by that word.

3. Five argumenes propoſed to prove that light is not a body.

But to come to our queſtion, upon the deciſion of which dependeth the fate of all the fictitious Entities which in the ſchools are termed qualities. The cheif motives that perſwade light to be one of thoſe; may, to my beſt remembrance, be reduced to five ſeverall heads. The firſt is, that it illuminateth the aire in an inſtant, and therefore cannot be a body: for a body requireth ſucceſſion of time to move in: whereas, this ſeemeth to ſpread it ſelf over the whole hemiſphere in an inſtant; for as farre as the ſunne is diſtant from us, he no ſooner raiſeth his head above our horizon, but his darts are in our face: and generally, no imagination can be framed, of any motion it hath in its dilatation.

The next is; that whereas no body can admit another into its place, without being removed away it ſelf, to leave that room unto the advenient one; nevertheleſſe, plain experience ſheweth us dayly, that two lights may be in the ſame place; and the firſt is ſo farre from going away at the coming of the ſecond, that the bringing in of a ſecond candle, and ſetting it near the firſt, encreaſeth the light in the room; which diminiſheth again when the ſecond is removed away. And by the ſame reaſon; if light were a body, it ſhould drive away the aire

(which is likewise a body) wheresoever it is admitted: for within the whole sphere of the irradiation of it, there is no point wherein one may set their eye, but light is found. And therefore, if it were a body there would be no room for aire in that place which light taketh up. And likewise, we see that it penetrateth all solid bodies, (and particularly glasse,) as experience sheweth, in wood, stone, metals, and any other body whatsoever, if it be made thinne enough.

The third argument, why light cannot be a body, is, that if it were so, it can be none other but fire, which is the subtilest, and most rarified of all bodies whatsoever. But if it be fire, then it cannot be without heat: and consequently, a man could not feel cold in a sunne-shining day. The contrary of which is apparent all winter long; whose brightest dayes oftentimes prove the coldest. And Galileus with divers others since, did use from the sunne to gather light in a kind of stone that is found in Italy (which is therefore by them called, *la calamita della luce*) and yet no heat appeared in it. A glow-worm will give light to read by, but not to warm you any whit at all. And it is said, that diamonds and carbuncles will shine like fire in the greatest darks; yet no man ever complained of being served by them as the foolish Satyre was by kissing of a burning coal. On the contray side; if one consider how great heats may be made without any light at all, how can one be perswaded that light & heat should be the same thing, or indeed any whit of kin?

The fourth motive to induce us to believe that light cannot be a body, is the sudden extinction of it, when any solid body cometh between the fountain of it, and the place where he sendeth his beams. What becometh of that great expansion of light that shined all about, when a cloud interposeth it self between the body of the sunne and the streams that come from it? Or when it leaveth our horizon to light the other world? His head is no sooner out of our sight; but at the instant all his beams are vanished. If that which filleth so vast a room were a body, something would become of it: it would at least be changed to some other substance; and some reliques would be left of it; as when ashes remain of burned bodies: for nature admitteth not the annihilation of any thing.

And in the last place; we may conceive that if light were a body,

dy, it would be shaken by the winds, and by the motion of the aire; and we should see it quaver in all blustering weather. Therefore, summing up all we have said; it seemeth most improbable, and indeed wholly impossible, that light should be a body; and consequently, must have his place among qualities.

But on the other side; before we apply our selves to answer these objections, let us make a short survey of those inducements, that prevail with us to believe light a body, notwithstanding so forcible oppositions. I admit so farre of the third argument, as to allow light to be fire: for indeed it cannot be imagined to be any thing else; all properties agreeing so fully between them. But withall I must adde; that it is not fire in every form, or fire joyned with every substance, that expresseth it self by light; but it is fire extremely dilated, and without mixture of any other grosse body. Let me hold a piece of linen or paper close by the flame of a candle, and by little and little, remove it further and further off; and me thinks my very eyes tell me, that there is upon the paper some part of that which I see in the candle; and that it groweth still lesse and lesse like as I remove the paper further from it: so that, if I would believe my sense, I should believe it as very a body upon the paper, as in the candle; though enfeebled, by the laxity of the channel in which it floweth.

4. The two first reasons to prove light to be a body are, the resemblance it hath with fire; and because if it were a quality, it would alwayes produce an equall to it self.

And this seemeth to be strengthened, by the consideration of the adversaries position: for if it were a quality; then, seeing it hath no contrary to destroy or stop it, it should still produce an equall to it self, without end or growing feeble, whensoever it meeteth with a subject capable to entertain it, as aire is.

The better to apprehend how much this faint resemblance of flame upon the paper, maketh for our purpose; let us turn the leaf, and imagine in our thoughts, after what fashion that fire which is in the flame of a little candle, would appear unto us, if it were dilated and stretched out to the utmost extent that excesse of rarity can bring it unto. Suppose that so much flame, as would fill a cone of two inches height and half an inch diameter should suffer so great an expansion as to repleniſh with his light body a large chamber: and then, what can we imagine it would seem to be? How would the continuall

5. The third reason; because if we imagine to our selves the substance of fire to be rarified, it will have the same appearances which light hath.

tinuall driving it into a thinner substance, as it streameth in a perpetuall floud from the flame; seem to play upon the paper? And then judge whether it be likely to be a body or no, when our discourse suggesteth unto us, that if it be a body, those very appearances must follow, which our eyes give us evidence are so in effect. If gold beaten into so aiery a thinnesse as we see guilders use, doth remain still gold notwithstanding the wonderfull expansion of it: why shall we not allow, that fire dilated to his utmost period, shall still remain fire; though extremely rarified beyond what it was?

6. The fourth reason, from the manner of the generation and corruption of light, which agreeth with fire.

We know that fire is the rarest and the subtilest substance that nature hath made among bodies; and we know likewise, that it is ingendered by the destroying and feeding upon some other more grosse body: let us then calculate, when the oyl, or tallow, or wax of a candle, or the bulk of a faggot or billet, is dilated and rarified to the degree of fire; how vast a place must it take up?

To this let us adde what Aristotle teacheth us; that fire is not like a standing pool, which continueth full with the same water; and as it hath no waste, so hath it no supply: but it is a fluent and brooklike current. Which also we may learn, out of the perpetuall nutriment it requireth: for a new part of fewell, being converted into a new part of fire (as we may observe, in the little atomes of oyl, or melted wax, that continually ascend apace up the week of a burning candle or lamp) of necessity the former must be gone to make room for the latter; and so, a new part of the river is continually flowing.

Now then, this perpetuall flux of fire, being made of a grosse body that so rarified will take up such a vast room; if it die not at the instant of its birth, but have some time to subsist (be it never so short,) it must needs runne some distance from the fountain whence it springeth. Which if it do; you need not wonder, that there should be so great an extent of fire as is requisite to fill all that space which light repleniseth; nor that it should be still supplyed with new, as fast as the cold of the aire killeth it: for considering that flame is a much grosser substance then pure fire, (by reason of the mixture with it, of that viscous oyly matter, which being drawn out of the wood and candle, serveth for fewell to the fire, and

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is by little and little converted into it; ) and withall reflecting upon the nature and motion of fire, ( which is, to dilate it self extremely, and to fly all about from the center to the circumference; )you cannot choose but conceive, that the pure fire struggling to break away from the oyly fewell ( which is still turning into new fire ) doth at length free his wings from that birdlime, and then flyeth abroad with extreme swiftnesse, and swelleth & dilateth it self to a huge bulk, now that it hath gotten liberty; and so filleth a vast room; but remaineth still fire till it die: which it no sooner doth, but it is still supplyed with new streams of it, that are continually strained, & as it were squeesed out of the thick flame, which did imprison it, and kept it within it; till growing fuller of fire then it could contain (by reason of the continuall attenuating the oyly parts of it, and converting them into fire) it giveth liberty unto those parts of fire, that are next the superficies, to fly whither their nature will carry them.

And thus, discourse would inform a blind man ( after he hath well reflected on the nature of fire ) how it must needs fill a mighty extent of place; though it have but a narrow beginning at the springhead of it: and that there, by reason of the condensation of it, and mixture with a grosser body, it must needs burn other bodies; but that when it is freed from such mixture, and suffereth an extreme expansion, it cannot have force to burn, but may have means to expresse it self to be there present by some operation of it upon some body that is refined and subtilized enough to perceive it. And this operation a seeing man will tell you is done upon his eyes, ( whose fitnesse to receive impression from so subtile an Agent, Anatomistes will teach you.) And I remember, how a blind schoolmaster that I kept in my house to teach my children, (who had extreme subtile spirits, and a great tendernesse through his whole body; and met with few distractions, to hinder him from observing any impression, never so nicely made upon him ) used often to tell me, that he felt it very preceptibly in severall parts of his body; but especially in his brain.

7. The fifth reason; because such properties belong to light as agree onely unto bodies.

But to settle us more firmly in the perswasion of light his being a body (and consequently fire;) let us consider that the properties of a body, are perpetually incident to light; look what rules a ball will keep in its rebounds; the same, doth light in its

its reflexions: and the same demonstration doth alike convince the one and the other. Besides, light is broken like a body; as when it is snapped in pieces by a tougher body. It is gathered together into a little room by looking or burning glasses; as water is, by ordering the gutters of a house so as to bring into one cistern all that raineth dispersedly upon the whole roof. It is severed and dispersed by other glasses; and is to be wrought upon, and cast hither and thither at pleasure; all by the rule of other bodies. And what is done in light, the same will likewise be done in heat, in cold, in wind, and in sound. And the very same instruments that are made for light, will work their effects in all these others, if they be duly managed.

So that certainly, were it not for the authority of Aristotle and of his learned followers that presseth us on the one side; and for the seemingnesse of those reasons we have already mentioned, which perswadeth us on the other side; our very eyes would carry us by stream into this consent, that light is no other thing but the nature and substance of fire, spred farre and wide, and freed from the mixture of all other grosse bodies. Which will appear yet more evident in the solutions of the oppositions we have brought against our own opinion: for in them there will occurre other arguments of no lesse importance to prove this verity, then these we have already proposed.

## CHAP. VII.

### *Two objections answered against light being fire; with a more ample proof of its being such.*

1. That all light is hot and apt to heat.

HAving then said thus much to perswade us of the corporeity of this subtile thing, that so queintly playeth with our eyes: we will in the next place examine those objections that at the beginning we did set down against its being a body: and if after a through discussion of them, we find they do in truth conclude nothing of what at the first sight they bear so great a shew of; but that we shall be able perfectly to solve and enerve their force; no body will think it rashnesse in us to crave leave of Aristotle that we may dissent from him in a matter that he hath not looked to the bottom of; and whose opinion therein can-

cannot be defended from plain contradictions and impossibilities. It is true, never any one man looked so farre as he into the bowels of nature; he may be rightly termed the Genius of it; and whosoever followeth his principles in the main, cannot be led into errour: but we must not believe that he or any man else that relieth upon the strength and negotiation of his own reason, ever had a priviledge of infallibility entailed to all he said. Let us then admire him for what he hath delivered us: and where he falleth short or is weary in his search, and suffereth himself to be born down by popular opinions against his own principles (which happeneth very seldome to him) let us seek to supply and relieve him.

But to pursue our intent: We will begin with answering the third objection; which is, that if light were fire, it must heat as well as enlighten where it shineth. There is no doubt but it doth so: as is evident by the weather-glasses, and other artificiall musicall instruments (as organs and virginals that played by themselves) which Cornelius Drebbel (that admirable master of mechanicks) made to shew the king. All which depended upon the rarefaction and condensation of some subtile body, conserved in a cavitie within the bulk of the whole instrument: for assoon as the sunne shined, they would have motion and play their parts. And there is no doubt but that grew out of the rarefaction of the subtile liquor he made use of, which was dilated assoon as the aire was warmed by the sunne-beams. Of whose operation it was so sensible, that they no sooner left the horizon, but its motion ceased. And if but a cloud came between the instrument and them, the musick would presently go slower time. And the ancient miracle of Memnons statue, seemeth to be a juggling of the Ethiopian Priests made by the like invention.

But though he and they found some spirituall and refined matter, that would receive such notable impressions, from so small alterations of temper; yet it is no wonder that our grosse bodies are not sensible of them: for we cannot feel heat unlesse it be greater then that which is in our sense. And the heat there must be in proportion to the heat of our bloud; which is an high degree of warmth. And therefore it is very possible.

2. The reason why our bodies for the most part do not feel the heat of pure light.

sible that an exceeding rarified fire, may cause a farre lesse impression of heat then we are able to feel. Consider how if you set pure spirit of wine on fire, and so convert it into actuall flame; yet it will not burn, nor scarce warm your hand: and then can you expect that the light of a candle which filleth a great room, should burn or warm you as far as it shineth?

If you would exactly know what degree of heat, and power of burning that light hath, which (for example) shineth upon the wall in a great chamber, in the middest whereof there standeth a candle; do but calculate what overproportion of quantitie all the light in the whole room beareth to the quantity of the little flame at the top of the candle, and that is the overproportion of the force of burning which is in the candle, to the force of burning which is in so much light at the wall as in extension is equall to the flame of the candle. Which when you have considered, you will not quarrell at its not warming you at that distance; although you grant it to be fire, streaming out from the flame as from the spring that feedeth it, and extremely dilated (according to the nature of fire, when it is at liberty) by going so farre, without any other grosse body to imprison or clog it.

It is manifest, that this rule of examining the proportion of burning in so much of the light as the flame is, (by calculating the proportion of the quantity or extension of all the light in the room to the extension of the flame of the candle, and then comparing the flame of the candle to a part of light equall in extension unto it) is a good and infallible one, if we abstract from accidentall inequalities: since both the light and the flame are in a perpetuall flux; and all the light was first in the flame, which is the spring from whence it continually floweth. As in a river wherein every part runneth with a settled stream; though one place be straighter, and another broader; yet of necessitie, since all the water that is in the broad place came out of the narrow, it must follow that in equall portions of time, there is no more water where it hath the liberty of a large channell, then where the banks presse it into a narrower bed, so that there be no inequalities in the bottome.

In like manner, if in a large stove a basin of water be converted

verted into steam; that rarified water which then filleth the whole stove, is no more then what the basin contained before: and consequently, the power of moistening which is in a foots extension (for example) of the stove wherein that steam is, must be in proportion to the virtue of wetting in the foots extension of water; as the quantity of that great room which the steam filleth, is to the quantity of the water contained in the basin: for although the rarified water be not in every least part of that great place it seemeth to take up; by reason that there is aire in which it must swim; yet the power of wetting that was in the basin of water, is dilated through the whole room, by the conjunction of the myst or dew to all the sensible parts of the aire that is in the room: and consequently the power of wetting which is in any foot of that room, is in a manner as much lesse then the power of wetting which was in the foot of water, as if the water were rarified to the quantity of the whole room, and no aire were left with it.

And in the same manner it fareth with dilated fire, as it doth with dilated water: with onely this difference peradventure, that fire groweth purer and more towards its own nature by dilatation; whereas water becometh more mixed and is carried from its nature by suffering the like effect. Yet dilated water will in proportion moysten more then dilated fire will burn; for the rarefaction of water bringeth it nearer to the nature of aire (whose chief propriety is moisture,) and the fire that accompanieth it when it raiseth it into steam, giveth it more powerfull ingression into what body it meeteth withall: whereas fire when it is very pure, and at entire liberty to stretch and spread it self as wide as the nature of it will carry it, getteth no advantage of burning by its mixture with aire: and although it gaineth force by its purity, yet by reason of its extreme rarefaction it must needs be extremely faint. But if by the help of glasses you will gather into lesse room that which is diffused into a great one; and so condense it as much as it is (for example) in the flame of a candle; then that fire or compacted light will burn much more forcibly then so much flame: for there is as much of it in quantity (excepting what is lost in the carriage of it;) and it is held in togethet in as little room; and it hath this advantage besides,

besides, that it is clogged with no grosse body to hinder the activity of it.

3. The experience of burning glasses, and of soultry gloomy weather, prove light to be fire.

It seemeth to me now, that the very answering this objection doth (besides repelling the force of it) evidently prove that light is nothing but fire in his own nature, and exceedingly dilated: for if you suppose fire (for example, the flame of a candle) to be stretched out to the utmost expansion that you may well imagine such a grosse body is capable of; it is impossible it should appear and work otherwise then it doth in light, as I have shewed above. And again, we see plainly that light gathered together burneth more forcibly then any other fire whatsoever, and therefore must needs be fire.

Why then shall we not confidently conclude, that what is fire before it getteth abroad, and is fire again when it cometh together, doth likewise remain fire during all its journey? Nay, even in the journey it self we have particular testimony that it is fire: for light returning back from the earth charged with little atomes (as it doth in soultry gloomy weather) heateth much more then before; just as fire doth when it is imprisoned in a dense body.

4. Philosophers ought not to judge of things by the rules of vulgar people.

Philosophers ought not to judge by the same rules that the common people doth. Their grosse sense is all their guide: and therefore they cannot apprehend any thing to be fire, that doth not make it self be known for such by burning them. But he that judiciously examineth the matter, and traceth the pedigree and period of it; and seeth the reason why in some circumstances it burneth, and in others it doth not; is too blame, if he suffer himself to be led by others ignorance contrary to his own reason. When they that are curious in perfumes, will have their chamber filled with a good sent in a hot season that agreeth not with burning perfumes, and therefore make some odoriferous water be blown about it by their servants mouths that are dexterous in that ministery, (as is used in Spain in the summer time;) every one that seeth it done, though on a sudden the water be lost to his eyes and touch, and is onely discernable by his nose; yet he is well satisfied that the sent which recreateth him, is the very water he saw in the glasse extremely dilated by the forcible sprouting of it out from the servants mouth, and will by little and little fall down and become again palpable

pable water as it was before; and therefore doubteth not but it is ſtill water whiles it hangeth in the aire divided into little atomes. Whereas one that ſaw not the beginning of this operation by water, nor obſerved how in the end it ſheweth it ſelf again in water, might the better be excuſed if he ſhould not think that what he ſmelled were water blown about the aire, nor any ſubſtance of it ſelf (becauſe he neither ſeeth nor handleth it) but ſome adventitious quality he knoweth not how adhering to the aire. The like difference is between Philoſophers that proceed orderly in their diſcourſes, and others that pay themſelves with terms which they underſtand not. The one ſee evidence in what they conclude; whiles the others gueſſe wildly at randome.

5. The different names of light and fire proceed from different notions of the ſame ſubſtance.

I hope the Reader will not deem it time loſt from our main drift, which we take up thus in examples and digreſſions: for if I be not much deceived, they ſerve exceedingly to illuſtrate the matter: which I hope I have now rendred ſo plain, as no man that ſhall have well weighed it, will expect that fire dilated into that rarified ſubſtance which mankind (who according to the different appearance of things to their ſenſe, giveth different names unto them) calleth light, ſhould burn like that groſſer ſubſtance which from doing ſo they call fire; nor doubt but that they may be the ſame thing more or leſſe attenuated; as leaf-gold that flyeth in the aire as light as down, is as truly gold as that in an ingot which being heavier then any other ſubſtance, falleth moſt forcibly unto the ground.

What we have ſaid of the unburning fire (which we call light) ſtreaming from the flame of a candle, may eaſily be applyed to all other lights deprived of ſenſible heat, whereof ſome appear with flame, others without it: of the firſt ſort of which, are the innoxious flames that are often ſeen on the hair of mens heads, and horſes manes, on the maſts of ſhips, over graves, and fat mariſh grounds, and the like: and of the latter ſort are glow-worms, and the light-conſerving ſtones, rotten wood, ſome kinds of fiſh and of fleſh when they begin to putrifie, and ſome other things of the like nature.

6. Now to anſwer the ſecond part of this objection, that we daily ſee great heats without any light, as well as much light with-

The reason why many times fire and heat are deprived of light.

without any heat, and therefore light and fire cannot be the same thing: you may call to mind how dense bodies are capable of great quantities of rare ones; and thereby it cometh to passe, that bodies which repugne to the dilatation of flame, may nevertheless have much fire enclosed in them. As in a stove, let the fire be never so great, yet it appeareth not outwards to the sight, although that stove warm all the rooms near it: So when many little parts of heat are imprisoned in as many little cells of grosse earthly substance, (which are like so many little stoves to them) that imprisonment will not hinder them from being very hot to the sense of feeling (which is most perceptible of dense things.) But because they are choaked with the closeness of the grosse matter wherein they are enclosed, they cannot break out into a body of flame or light, so to discover their nature: which (as we have said before) is the most unfit way for burning; for we see that light must be condensed to produce flame and fire; as flame must be to burn violently.

7. What becometh of the body of light when it dieth.

Having thus cleared the third objection, (as I conceive;) let us go on to the fourth; which requireth that we satisfie their inquisition, who ask what becometh of that vast body of shining light (if it be a body) that filleth all the distance between heaven and earth; and vanisheth in a moment assoon as a cloud or the moon interposeth it self between the sunne and us, or that the sunne quitteth our hemisphere? No signe at all remaineth of it after the extinction of it, as doth of all other substances, whose destruction is the birth of some new thing. Whither then is it flown? We may be perswaded that a myst is a corporeall substance, because it turneth to drops of water upon the twigs that it invironeth: and so we might believe light to be fire, if after the burning of it out, we found any ashes remaining; but experience assureth us, that after it is extinguished, it leaveth not the least vestigium behind it of having been there.

Now, before we answer this objection, we will entreat our adversary to call to mind, how we have in our solution of the former declared and proved that the light, which (for example) shineth from a candle, is no more then the flame is, from whence it springeth, the one being condensed and the other dilated; and that the flame is in a perpetuall flux of consumption about

about the circumference, and of reſtauration at the center, where it ſucketh in the fewell: and then we will enquire of him, what becometh of that body of flame which ſo continually dieth and is renewed, and leaveth no remainder behind it; as well as he doth of us, what becometh of our body of light, which in like manner is alwayes dying and alwayes ſpringing freſh? And when he hath well conſidered it, he will find that one anſwer will ſerve for both.

Which is, That as the fire ſtreameth out from the fountain of it, and groweth more ſubtile by its dilatation, it ſinketh the more eaſily into thoſe bodies it meeteth withall: the firſt of which and that environeth it round about, is aire. With aire then it mingleth and incorporateth it ſelf, and by conſequence with the other little bodies that are mingled with the aire: and in them it receiveth the changes which nature worketh: by which it may be turned into the other elements, if there be occaſion; or be ſtill conſerved in bodies that require heat.

8. An experiment of ſome who pretend, that light may be precipitated into powder.

Upon this occaſion, I remember a rare experiment that a noble man of much ſincerity, and a ſingular friend of mine, told me he had ſeen: which was, That by means of glaſſes made in a very particular manner, and artificially placed one by another, he had ſeen the ſun-beams gathered together, and precipitated down into a browniſh or purpliſh red powder. There could be no fallacy in this operation: for nothing whatſoever was in the glaſſes when they were placed and diſpoſed for this intent: and it muſt be in the hot time of the yeare, elſe the effect would not follow. And of this Magiſtry he could gather ſome dayes near two ounces in a day. And it was of a ſtrange volatile nature, and would pierce and imprint his ſpirituall quality into gold it ſelf (the heavieſt and moſt fixed body we converſe withall) in a very ſhort time. If this be plainly ſo, without any miſtaking; then mens eyes and hands may tell them what becometh of light when it dieth, if a great deal of it were ſwept together. But from what cauſe ſoever this experience had its effect, our reaſon may be ſatisfied with what we have ſaid above; for I confeſſe, for my part, I believe the appearing body might be ſomething that came along with the ſun-beams, and was gathered by them; but not their pure ſubſtance.

Some peradventure will object thoſe lamps, which both ancient

9. The Authours opinion concerning lamps pretended to have been found in tombes with inconsumptible lights.

cient and modern writers have reported to have been found in tombes and urns, long time before closed up from mens repair unto them to supply them with new fewell: and therefore they believe such fires to feed upon nothing; and consequently, to be inconsumptible and perpetuall. Which if they be, then our doctrine that will have light to be nothing but the body of fire perpetually flowing from its center, and perpetually dying; cannot be found: for in time such fires would necessarily spend themselves in light: although light be so subtile a substance that an exceeding little quantity of fewell may be dilated into a vast quantity of light. Yet still there would be some consumption, which how imperceptible soever in a short time, yet after a multitude of revolutions of years, it must needs discover it self.

To this I answer: That for the most part, the witnesses who testifie originally the stories of these lights, are such as a rationall man cannot expect from them that exactnesse or nicetie of observation, which is requisite for our purpose; for they are usually grosse labouring people, who as they dig the ground for other intentions, do stumble upon these lamps by chance before they are aware: and for the most part, they break them in the finding; and they imagine they see a glimpse of light, which vanisheth before they can in a manner take notice of it; and is peradventure but the glistering of the broken glasse or glazed pot, which reflecteth the outward light, assoon as by rummaging in the ground and discovering the glasse, the light striketh upon it; (in such manner as sometimes a diamond by a certain encountring of light in a dusky place, may in the first twickling of the motion, seem to sparkle like fire:) and afterwards when they shew their broken lamp, and tell their tale to some man of a pitch of wit above them, who is curious to inform himself of all the circumstances that may concern such lights; they strain their memory to answer him satisfactorily unto all his demands: and thus for his sake they perswade themselves to remember what they never saw: and he again on his side, is willing to help out the story a little. And so after a while, a very formall and particular relation is made of it. As happeneth in like sort in reporting of all strange and unusuall things; which even those that in their nature

nature abhorre from lying are naturally apt to strain a little and fashion up in a handsome mould; and almost to perswade themselves they saw more then they did: so innate it is to every man, to desire the having of some preeminence beyond his neighbours; be it but in pretending to have seen something which they have not.

Therefore, before I engage my self in giving any particular answer to this objection of pretended inconsumptible lights, I would gladly see the effect certainly averred and undoubtedly proved: for, the testimonies which Fortunius Licetus produceth (who hath been very diligent in gathering them, and very subtile in discoursing upon them; and is the exactest Authour that hath written upon this subject) do not seem unto me to make that certainty, which is required for the establishing of a ground in Philosophy. Nevertheless, if there be any certain experience in this particular, I should think that there might be some Art by circulation of fewell, to maintain the same light for a great company of years. But I should not easily be perswaded, that either flame or light could be made without any manner of consuming the body which serveth them for fewell.

## CHAP. VIII.

### *An answer to three other objections formerly proposed, against light being a substance.*

HAving thus defended our selves from their objections, who would not allow light to be fire; and having satisfied their inquisition, who would know what becometh of it when it dyeth, if it be a body: we will now apply our selves to answer their difficulties, who will not let it passe for a body, because it is in the same place with an other body; as, when the sunne-beams enlighten all the aire, and when the severall lights of two distinct candles are both of them every where in the same room. Which is the substance of the second main objection.

1. Light is not really in every part of the room it enlightneth, nor filleth entirely any sensible part of it, though it seem to us to do so.

This of the justling of the aire, is easily answered thus: that the aire being a very divisible body, doth without resistance yield as much place as is requisite for light. And that light,

though our eyes judge it diffused every where, yet is not truly in every point or atome of aire: but to make us see it every where, it sufficeth that it be in every part of the aire which is as big as the black or sight of our eye; so that we cannot set our eye in any position where it receiveth not impressions of light. In the same manner as perfumes; which though they be so grosse bodies that they may be sensibly wafted by the wind; nevertheless, they do so fill the aire, that we can put our nose in no part of the room, where a perfume is burned, but we shall smell it. And the like is of mists; as also of the sprouted water to make a perfume, which we mentioned above.

But because pure discourses, in such small thrids as these, do but weakly bind such readers as are not accustomed unto them; and that I would (if it be possible) render this Treatise intelligible to every rationall man, how ever little versed in scholastick learning (among whom I expect it will have a fairer passage, then among those that are already deeply imbued with other principles:) let us try if we can herein inform our selves by our sense, and bring our eyes for witnesse of what we say. He then that is desirous to satisfie himself in this particular, may put himself in a dark room, through which the sunne sendeth his beams by a cranie or little hole in the wall; and he will discover a multitude of little atomes flying about in that little stream of light; which his eye cannot discerne when he is environed on all sides with a full light. Then let him examine whether or no there be light in the midst of those little bodies: and his owne reason will easily tell him, that if those bodies were as perspicuous as the aire, they would not reflect upon our eyes the beames by which we see them. And therefore he will boldly conclude, that at the least such parts of them as reflect light unto us, do not admit it, nor let it sink into them. Then let him consider the multitude of them; and the little distance betwixt one another; and how nevertheless they hinder not our sight; but we have it free to discover all objects beyond them, in what position soever we place our eye: and when he thus perceiveth that these opacous bodies, which are every where, do not hinder the eye from judging light to have an equall plenary diffusion through the whole place that it irradiateth; he can have no difficulty to allow aire, (that is diaphanous,

phanous, and more subtile far then they and consequently, divisible into lesser atomes, and having lesser pores, giveth lesse scope unto our eyes to misse light, then they do) to be every where mingled with light, though we see nothing but light, and cannot discern any breach or division of it.

Especially, when he shall adde unto this consideration; that the subtile body which thus filleth the aire, is the most visible thing in the world; and that, whereby all other things are seen: and that the aire which it mingleth it selfe with, is not at all visible, by reason of the extreme diaphaneity of it, and easie reception of the light into every pore of it without any resistance or reflection: and that such is the nature of light, as it easily drowneth an obscure body, if it be not too big: and not onely such, but even other light bodies; for so we know as well the fixed starres as the planets are concealed from our sight, by nearnesse to the sunne; neither the lightnesse of the one, nor the bignesse of the other, prevailing against the darkning of an exuperant light: and we have daily experience of the same in very pure chrystall glasses, and in very clear water; which though we cannot discern by our sight if they be in certain positions; nevertheless by experience we find that they reflect much light: and consequently have great store of opacous parts: and then he cannot choose but conclude, that it is impossible but light should appear at it doth, to be every where, and to be one continued thing; though his discourse withall assure him it is every where mingled with aire.

And this very answer I think will draw with it by consequence, the solution of the other part of the same objection; which is, of many lights joyning in the same place; and the same is likewise concerning the images of colours every where crossing one another without hinderance. But to raise this contemplation a strain higher; let us consider how light being the most rare of all known bodies, is of its own nature (by reason of the divisibility that followeth rarity) divisible into lesser parts then any other; and particularly then flame; which being mixed with smoke and other corpulency, falleth very short of light. And this, to the proportion in which it is more rare then the body it is compared unto. Now a great Mathematician having devised how to measure the rarefaction of gunne-pow-

2.
The least sensible point of a diaphanous body, hath room sufficient to contain both aire and light, together with a multitude of beams issuing from severall lights, without penetrating one another.

*Willebrord Snell*

der into flame, found the diameter 50. times encreased; and so concluded, that the body of the flame was in proportion to the body of the gunne-powder it was made of, as 125000. is to one. Wherefore by the immediately proceeding consequence, we find that 125000. parts of flame may be couched in the room of one least part of gunne-powder, and peradventure many more, considering how porous a body gunne-powder is. Which being admitted, it is evident that although light were as grosse as the flame of gunne-powder, and gunne-powder were as solide as gold; yet there might passe 125000. rayes of light, in the space wherein one least part of gunne-powder might be contained; which space would be absolutely invisible unto us, and be contained many times in the bigness of the sight of a mans eye. Out of which we may gather what an infinity of objects may seem unto us to crosse themselves in the same indivisible place, and yet may have room sufficient for every one to passe his way, without hindering his fellow. Wherefore, seeing that one single light could not send rayes enough to fill every little space of aire that is capable of light, (and the lesse, the further it is from the flame) it is obvious enough to conceive, how in the space where the aire is, there is capacity for the rayes of many candles.

Which being well summed up, will take away the great admiration how the beams of light, though they be corporeall, can in such great multitudes without hindering one another, enter into bodies and come to our eye: and will shew that it is the narrowness of our capacities, and not the defect of nature, which maketh these difficulties seem so great; for she hath sufficiently provided for all these subtile operations of fire; as also for the entrance of it into glasse, and into all other solide bodies that are diaphanous (upon which was grounded the last instance the second objection pressed:) for all such bodies being constituted by the operation of fire (which is alwayes in motion) there must needs be wayes left for it both to enter in, and to evaporate out. And this is most evident in glasse which being wrought by an extreme violent fire and swelling with it, as water and other things do by the mixture of fire; must necessarily have great store of fire in it self whiles it is boyling; as we see by its being red hot. And hence it is, that the workmen

are

are forced to let it cool by degrees in such relentings of fire, as they call their nealing heats, lest it should shiver in pieces by a violent succeeding of aire in the room of the fire; for that being of greater parts then the fire, would strain the pores of the glasse too suddenly, and break it all in pieces to get ingression: whereas in those nealing heats the aire being rarer, lesser parts of it succeed to the fire, and leisurely stretch the pores without hurt. And therefore we need not wonder that light passeth so easily through glasse; and much lesse, that it getteth through other bodies; seeing the experience of Alchymists doth assure us, that it is hard to find any other body so impenetrable as glasse.

3. That light doth not enlighten any room in an instant; and that the great celerity of its motion doth make it imperceptible to our senses

But now to come to the answer of the first, and in appearance most powerfull, objection against the corporeity of light; which urgeth that his motion is performed in an instant, and therefore cannot belong to what is materiall and clothed with quantity. We will endeavour to shew how unable the sense is to judge of sundry sorts of motions of Bodies, and how grossely it is mistaken in them. And then, when it shall appear that the motion of light must necessarily be harder to be observed then those others: I conceive, all that is raised against our opinion by so incompetent a judge, will fall flat to the ground.

First then, let me put the Reader in mind, how if ever he marked children when they play with fire-sticks, they move and whirle them round so fast, that the motion will cosen their eyes, and represent an entire circle of fire unto them: and were it somewhat distant, in a dark night, that one played so with a lighted torch, it would appear a constant wheel of fire without any discerning of motion in it. And then, let him consider how slow a motion that is in respect of what it is possible a body may participate of: and he may safely conclude, that it is no wonder though the motion of light be not descried, and that indeed no argument can be made from thence, to prove that light is not a body.

But let us examine this consideration a little further, and compare it to the motion of the earth or heavens: let the appearing circle of the fire, be some three foot diameter, and the

time of one entire circulation of it, be the sixtieth part of a minute; of which minutes, there are 60. in an houre; so that in a whole day, there will be but 86400. of these parts of time. Now the diameter of the wheel of fire being but of three foot, the whole quantity of space that it moveth in that atome of time will be at the most 10, foot; which is three paces and a foot: of which parts, there are near eleven millions in the compasse of the earth: so that if the earth be moved round in 24. hours, it must go near 130. times as fast as the boyes stick doth, which by its swift motion deceiveth our eye. But if we allow the sunne, the moon, and the fixed starres to move; how extreme swift must their flight be, and how imperceptible would their motion be in such a compasse as our sight would reach unto? And this being certain, that whether the earth or they do move, the appearances to us are the same; it is evident, that as now they cannot be perceived to move (as peradventure they do not;) so it would be the very same in shew to us, although they did move. If the sunne were near us, and galloped at that rate; surely we could not distinguish between the beginning and ending of his race: but there would appear one permanent line of light from East to West, without any motion at all: as the torch seemeth to make, with so much a slower motion, one permanent immoveable wheel of fire.

But contrary to this effect, we see that the sunne and starres by onely being removed further from our eyes, do cosen our sight so grossely that we cannot discern them to be moved at all. One would imagine that so rapide and swift a motion, should be perceived in some sort or other, (which, whether it be in the earth, or in them, is all one to this purpose.) Either we should see them change their places whiles we look upon them, as arrows and birds do when they fly in the aire: or else, they should make a stream of light bigger then themselves, as the torch doth. But none of all this happeneth: let us gaze upon them so long and so attentively that our eyes be dazeled with looking, and all that while they seem to stand immovable: and our eyes can give us no account of their journey till it be ended. They discern it not whiles it is in doing:

so

so that if we consult with no better counselour then them, we may wonder to see that body at night setting in the West, which in the morning we beheld rising in the East.

But that which seemeth to be yet more strange, is, that these bodies move crosse us, and nevertheless are not perceived to have any motion at all. Consider then how much easier it is for a thing that moveth towards us, to be with us before we are aware. A nimble fencer will put in a thrust so quick, that the foil will be in your bosome, when you thought it a yard off; because in the same moment you saw his point so farre distant, and could not discern it to move towards you, till you felt the rude salutation it gave you. If then you will compare the body of light with these others that thus deceive us in regard of motion; you must needs agree it is much rashnesse to conclude it hath no motion, because we cannot discern the succession of. Consider that it is the subtilest of all the bodies that God hath made. Examine the paths of it, which for the smallnesse of their thrids, and the extreme divisibility of them, and their pliant application of themselves to whatsoever hath pores, are almost without resistance. Calculate the strange multiplication of it, by a perpetuall momentary renovation of its streams. And cast with your self, with what extreme force it springeth out and flyeth abroad. And on the other side, reflect how all these things are directly opposite and contrary in those other great bodies, whose motion nevertheless appeareth not unto us till it be done and past. And when you have well weighed all this; you must needs grant that they who in this case guide themselves merely by what appeareth unto their eyes, are ill judgers of what they have not well examined.

4. The reason why the motion of light, is not discerned coming towards us; and that there is some reall tardity in it.

But peradventure some who cannot all of a sudden be weaned from what their sense hath so long fed them with; may ask yet further, How it chanceth that we have no effects of this motion? It sheweth not it self in the aire, coming to us afarre off. It stayeth not a thought, or slackneth his speed in flying so vast a space as is from the sunne to us. In fine, there is no discovery of it.

But if Galileus his conception be well grounded; that lightning giveth us an incling of its motion, beginning from a little and encreasing to a greater; or if Monsieur des Cartes his opinion that it goeth slower in refraction, be true: we shall not need to study long for an answer. But in Galileus his experience, it may be the breaking of the cloud which receiveth that succession of motion which we see: and no slowness that light can acquire by the resistance of the refracting body can be so great as to make that difference of lines which Monsieur Des Cartes most ingeniously (though I much doubt not truly) hath applyed to yield the reason of refraction: as will appear in our further discourse.

Therefore, these being uncertain; we will, to shew the unreasonableness of this question, suppose there may be some observable tardity in the motion of light; and then ask of them, how we should arrive to perceive it? What sense should we imploy in this discovery? It is true, we are satisfied that sound taketh up time in coming to our eares: but it is, because our eyes are nimbler then they, and can perceive a good way distant the carpenters ax falling upon the timber that he heweth, or the fire flashing out of the canon, before they heare any newes of them: but shut your eyes; or inquire of a blind man; and then neither you nor he can tell whither those sounds fill your eares at the very instant they were begotten, or have spent some time in their journey to you. Thus then our eyes instruct our eares. But is there any sense quicker then the sight? or means to know speedier then by our eyes? Or can they see light, or any thing else; untill it be with them? We may then assuredly conclude, that its motion is not to be discerned as it cometh upon us; nor it self to be perceived, till its beams are in our eyes.

But if there were any means to discover its motion, surely it must be in some medium, through which it must struggle to get, as fire doth through iron; which increasing there by degrees, at last (when it is red hot) sendeth beams of light quite through the plate that at the first refused them passage. And it maketh to this purpose, that the light-conserving stones which are gathered in Italy, must be set in the sunne for some while before they retain light: and the light will appear in them when

when they are brought back into the dark, greater or lesser (untill they come to their utmost period) according as they have been longer or a lesser while in the sunne. And our eyes the longer they remain in the light, the more dazeled they are if they be suddenly passed into the dark. And a curious experiencer did affirm, that the likenesse of any object (but particularly he had often observed it of an iron grate) if it be strongly inlightned will appear to another, in the eye of him that looketh strongly and steadily upon it till he be dazeled by it; even after he shall have turned his eyes from it. And the wheel of fire could never be made appear unto our eye by the whirling of the firestick we even now spoke of; unlesse the impression made by the fire from one place, did remain in the eye a while after the fire was gone from the place whence it sent that ray. Whence it is evident, that light, and the pictures of objects, do require time to settle and to unsettle in a subject. If then light maketh a greater impression with time, why should we doubt but the first cometh also in time; were our sense so nimble as to perceive it?

5. The planets are not certainly ever in that place where they appear to be.

But then it may be objected, that the sunne would never be truly in that place in which unto our eyes it appeareth to be: because that, it being seen by means of the light which issueth from it; if that light required time to move in, the sunne (whose motion is so swift) would be removed from the place where the light left it, before it could be with us to give tidings of him. To this I answer, allowing that peradventure it may be so. Who knoweth the contrary? Or, what inconvenience would follow, if it be admitted? Indeed, how can it be otherwise? In refraction, we are sure it is so: and therefore at no time but when the sunne is perpendicularly over our heads, we can be certain of the contrary although it should send its light to us in an instant. Unlesse happely the truth of the case should be, that the sunne doth not move about us; but we turn to his light: and then, the objection also loseth its aim.

6. The reason why light being a body, doth not by its motion shatter other bodies into pieces.

But the more we presse the quickneſse of light; the more we ingage our selves in the difficulty why light doth not shatter the aire in pieces, as likewise all solid bodies whatsoever: for the masters of naturall Philosophy do tell us, that a softer thing with

with a great velocity, is as powerfull in effect when it giveth a blow, as a harder thing going ſlowly. And accordingly experience teacheth us, that a tallow candle ſhot in a gun will go through a board or kill a man. Wherefore light having ſuch an infinite celerity, ſhould alſo have an unreſiſtable force, to pierce and ſhatter, not onely the aire, but even the hardeſt bodies that are. Peradventure ſome may think it reaſonable to grant the conſequence (in due circumſtances) ſince experience teacheth us, that the congregation of a little light by a glaſſe, will ſet very ſolid bodies on fire, and will melt metals in a very ſhort ſpace; which ſheweth a great activity: and the great activity ſheweth a great percuſſion, burning being effected by a kind of attrition of the thing burned. And the great force which fire ſheweth in gunnes, and in mines, being but a multiplication of the ſame, doth evidently convince that of its own nature it maketh a ſtrong percuſſion, when all due circumſtances concurre. Whereas it hath but little effect if the due circumſtances be wanting; as we may obſerve in the inſenſible burning of ſo rarified a body as pure ſpirit of wine converted into flame.

But we muſt examine the matter more particularly, and muſt ſeek the cauſe why a violent effect doth not alwayes appear, whereſoever light ſtriketh; for the which we are to note that three things do concurre to make a percuſſion great: The bigneſſe, the denſity, and the celerity of the body moved. Of which three there is onely one in light; to wit, celerity: for it hath the greateſt rarity, and the rayes of it are the ſmalleſt parcels of all naturall bodies. And therefore ſince onely celerity is conſiderable in the account of lights percuſſions, we muſt examine what celerity is neceſſary to make the ſtroke of a ray ſenſible: firſt then we ſee that all the motes of the aire, nay even feathers and ſtraws, do make no ſenſible percuſſion when they fall upon us: therefore we muſt in light have at the leaſt a celerity that may be to the celerity of the ſtaw falling upon our hand (for example,) as the denſity of the ſtraw is to the denſity of light, that the percuſſion of light may be in the leaſt degree ſenſible. But let us take a corn of gunpowder in ſtead of a ſtraw (between which there cannot be much difference) and then putting that the denſity of fire is to the denſity of gunpowder as

1.

1. to 125000; and that the denſity of the light we have here in the earth, is to the denſity of that part of fire which is in the ſunnes body, as the body of the ſunne is to that body which is called *Orbis magnus* (whoſe ſemidiameter is the diſtance between the ſunne and the earth;) which muſt be in ſubtriple proportion of the diameter of the ſunne to the diameter of the great orb: it followeth that 125000. being multiplyed by the proportion of the great orb unto the ſunne (which Galileo telleth us is as 106000000. unto one) will give a ſcantling of what degree of celerity light muſt have more then a corn of gunpowder, to recompence the exceſſe of weight which is in a corn of gunpowder, above that which is in a ray of light, as big as a corn of gunpowder. Which will amount to be much greater then the proportion of the ſemidiater of *Orbis magnus*, to the ſemidiater of the corn of gunpowder: for if you reckon five grains of gunpowder to a barly-corns breadth, and 12. of them in an inch, and 12. inches in a foot, and 3. feet in a pace, and 1000. paces in a mile, and 3500. miles in the ſemidiameter of the earth, and 1208. ſemidiameters of the earth in the ſemidiameter of the *Orbis magnus*, there will be in it but 913248000000. grains of gunpowder; whereas the other calculation maketh light to be 1325000000000. times rarer then gunpowder; which is almoſt ten times a greater proportion then the other. And yet this celerity ſupplyeth but one of the two conditions wanting in light to make its percuſſions ſenſible, namely denſity. Now becauſe the ſame velocity in a body of a leſſer bulk, doth not make ſo great a percuſsion as it doth in a bigger body; and that the littleneſſe of the leaſt parts of bodies followeth the proportion of their rarity; this vaſt proportion of celerity muſt again be drawn into it ſelf, to ſupply for the exceſſe in bigneſſe that a corn of gunpowder hath over an atome of light: and the product of this multiplication will be the celerity required to ſupply for both defects. Which evidently ſheweth, it is impoſsible that a ray of light ſhould make any ſenſible percuſsion, though it be a body. Eſpecially conſidering that ſenſe never taketh notice of what is perpetually done in a moderate degree. And therefore after this minute looking into all circumſtances, we need not have difficulty in allowing unto light the greateſt celerity imaginable, and a percuſsion proportionate to ſuch a celerity in ſo rare a body;

and

and yet not fear any violent effect from its blows: unlesse it be condensed, and many parts of it be brought together to work as if they were but one.

7. The reason why the body of light is never perceived to be fanned by the wind.

As concerning the last objection; that if light were a body, it would be fanned by the wind: we must consider what is the cause of a things appearing to be moved: & then examine what force that cause hath in light. As for the first part; we see that when a body is discerned now in one place, now in another, then it appeareth to be moved. And this we see happeneth also in light; as when the sunne or a candle is carried or moveth, the light thereof in the body of the candle or sunne seemeth to be moved along with it. And the like is in a shining cloud or comet.

But to apply this to our purpose: We must note that the intention of the objection is, that the light which goeth from the fire to an opacous body farre distant without interruption of its continuity, should seem to be jogged or put out of its way by the wind that crosseth it. Wherein the first failing is, that the objector conceiveth light to send species unto our eye from the midst of its line: whereas with a little consideration he may perceive, that no light is seen by us but that which is reflected from an opacous body to our eye: so that the light he meaneth in his objection is never seen at all. Secondly, it is manifest that the light which striketh our eye, doth strike it in a straight line; and seemeth to be at the end of that straight line, whersoever that is; and so can never appear to be in another place: but the light which we see in another place, we conceive to be another light. Which maketh it again evident, that the light can never appear to shake, though we should suppose that light may be seen from the middle of its line; for no part of wind or aire can come into any sensible place in that middle of the line, with such speed that new light from the source doth not illuminate it sooner then it can be seen by us: wherefore it will appear to us illuminated, as being in that place: and therefore the light can never appear shaken. And lastly, it is easier for the aire or wind to destroy the light, then it is to remove it out of its place, wherefore it can never so remove it out of its place, as that we should see it in another place. But if it should remove it, it would wrap it up within it self and hide it.

8. In conclusion; after this long dispute concerning the nature of

of light: if we consider well what hath been said on both sides (to which much more might be added, but that we have already trespassed in length, and I conceive enough is said to decide the matter) an equall judge will find the ballance of the question to hang upon these termes: that, to prove the nature of light to be materiall and corporeall, are brought a company of accidents well known to be the proprieties of quantitie or bodies; and as well known to be in light. Even so farre as that it is manifest that light in its beginning before it be dispersed is fire; and if again it be gathered together, it sheweth it self again to be fire. And the receptacles of it are the receptacles of a body: being a multitude of pores, as the hardnesse and coldnesse of transparent things do give us to understand; of which we shall hereafter have occasion to discourse.

The reasons for & against lights being a body, compared together.

On the contrary side, whatsoever arguments are brought against lights being a body, are onely negatives. As that we see not any motion of light; that we do not discern where the confines are between light and aire; that we see not room for both of them, or for more lights to be together; and the like: which is to oppose negative proofs against affirmative ones; and to build a doctrine upon the defect of our senses; or upon the likenesse of bodies which are extremely unlike, expecting the same effects from the most subtile as from the most grosse ones. All which together with the authority of Aristotle and his followers, have turned light into darknesse, and have made us almost deny the light of our own eyes.

9.

A summary repetition of the reasons which prove that light is fire.

Now then, to take our leave of this important question: let us return to the principles from whence we began, and consider; that seeing fire is the most rare of all the Elements, and very dry: and that out of the former it hath, that it may be cut into very small pieces; and out of the latter, that it conserveth its own figure, and so is apt to divide whatsoever fluide body: and joyning to these two principles, that it multiplyeth extremely in its source. It must of necessity follow, that it shooteth out in great multitudes little small parts into the aire and into other bodies circumfused with great dilatation in a spherical manner. And likewise that these little parts are easily broken; and new ones still following the former, are still multiplyed in straight lines from the place where they break. Out of which it is evident

dent that of necessity it must in a manner fill all places, and that no sensible place is so little, but that fire will be found in it, if the medium be capacious. As also, that its extreme least parts will be very easily swallowed up in the parts of the aire, which are humide; and by their enfolding, be as it were quite lost; so as to lose the appearance of fire. Again; that in its reflections, it will follow the nature of grosser bodies, and have glidings like them; which is that, we call refractions. That little streamings from it will crosse one another in excessive great numbers, in an unsensible part of space, without hindring one another. That its motion will be quicker then sense can judge of; and therefore will seem to move in an instant, or to stand still as in a stagnation. That if there be any bodies so porous with little and thick pores; as that the pores arrive near unto equalling the substance of the body; then, such a body will be so filled with these little particles of fire, that it will appear as if there were no stop in its passage, but were all filled with fire; and yet, many of these little parts will be reflected. And whatsoever qualities else we find in light, we shall be able to derive them out of these principles, and shew that fire must of necessitie do what experience teacheth us that light doth. That is to say in one word, it will shew us that fire is light. But if fire be light, then light must needs be fire. And so we leave this matter

## CHAP. IX.

### *Of Locall motion in common.*

1. No locall motion can be performed without succession.

THough in the fifth chapter, we made onely earth the pretender in the controversie against fire for superiority in activity; (and in very truth, the greatest force of gravity doth appear in those bodies which are eminently earthy:) nevertheless, both water and aire (as appeareth out of the 4. chapter of the Elements) do agree with earth in having gravity. And gravity, is the chief virtue to make them efficients. So that upon the matter, this plea is common to all the three Elements.

Wherefore, to explicate this virtue, whereby these three weighty Elements do work; let us call to mind what we said in the beginning of the last chapter concerning locall motion: to wit, that according as the body moved, or the divider did more and more enter into the divided body; so, it did joyn it self to some

some new parts of the medium or divided body, and did in like manner forsake others. Whence it happeneth that in every part of motion, it possesseth a greater part of the medium then it self can fill at once. And because by the limitation and confinednesse of every magnitude unto just what it is, and no more; it is impossible that a lesser body should at once equalise a greater: it followeth that this division or motion whereby a body attaineth to fill a place bigger then it self, must be done successively: that is, it must first fill one part of the place it moveth in, then another; and so proceed on, till it have measured it self with every part of the place from the first beginning of the line of motion to the last period of it where the body resteth.

By which discourse it is evident, that there cannot in nature be a strength so great as to make the least or quickest moveable that is, to passe in an instant, or all together, over the least place that can be imagined: for that would make the moved body (remaining what it is, in regard of its bignesse) to equalise and fit a thing bigger then it is. Therefore it is manifest, that motion must consist of such parts as have this nature, that whiles one of them is in being, the others are not yet: and as by degrees every new one cometh to be; all the others that were before, do vanish and cease to be. Which circumstance accompanying motion, we call Succession.

2. Time is the common measure of all succession.

And whatsoever is so done, is said to be done *in time*: which is the common measure of all succession, for the change of situation of the starres, but especially of the sunne and moon, is observed more or lesse by all mankind: and appeareth alike to every man: and (being the most known, constant, and uniform succession that men are used unto) is as it were by nature it self set in their way and offered unto them as fittest to estimate and judge all other particular successions, by comparing them both to it, and among themselves by it. And accordingly we see all men naturally measure all other successions, and expresse their quantities, by comparing them to the revolutions of the heavens; for dayes, houres, and years, are nothing else but they, or some determinate parts of them: unto some of which, all other motions and successions must of necessity be referred, if we will measure them. And thus we see how all the mystery of applying time unto particular motions, is nothing else but the considering

considering how farre the Agent that moveth the sunne, causeth it to go on in its journey, whiles the Agent that moveth a particular body, causeth it to perform its motion.

3. What velocity is, and that it cannot be infinite.

So that it is evident, that velocity is the effect of the superproportion of the one Agent over a certain medium; in respect of the proportion which another Agent hath to the same medium. And therefore, velocity is a quality by which one succession is intrinsically distinguished from another: though our explication, useth to include time in the notions of velocity and tardity. Velocity then, is the effect (as we said) of more strength in the Agent. And having before expressed, that velocity is a kind of density; we find that this kind of density is an excellency in succession; as permanent density, is an excellency in the nature of substance; though an imperfection in the nature of quantity (by which we see, that quantity is a kind of base alloy added to substance.) And out of this it is evident, that by how much the quicker the motion is in equall mediums, by so much the agent is the perfecter which causeth it to be so quick. Wherefore, if the velocity should ascend so much as to admit no proportion betweene the quickness of the one and the tardity of the other, all other circumstances being even, excepting the difference of the agents; then there must be no proportion between the agents. Nor indeed can there be any proportion between them though there were never so great differences in other circumstances, as long as those differences be within any proportion. And consequently, you see that if one agent be supposed to move in an instant, and another in time; whatsoever other differences be in the bodies moved and in the mediums; nevertheless the agent which causeth motion in an instant will be infinite in respect of the agent which moveth in time. Which is impossible: it being the nature of a body, that greater quantity of the same thing hath greater virtue, then a lesse quantity hath; and therefore, for a body to have infinite virtue, it must have infinite magnitude.

If any should say the contrary; affirming that infinite virtue may be in a finite body; I ask, whether in half that body (were it divided) the virtue would be infinite or no? If he acknowledge that it would not; I inferre thence, that neither in the two parts together there can be infinite virtue: for two finites cannot compose

pose and make up one infinite. But if he will have the virtue be infinite in each half, he therein alloweth that there is no more virtue, in the whole body then in one half of it: which is against the nature of bodies. Now that a body cannot be infinite in greatnesse, is proved in the second knot of Master Whites first Dialogue of the world. And thus it is evident, that by the virtue of pure bodies there can be no motion in an instant.

4. No force so little, that is not able to move the greatest weight imaginable.

On the other side it followeth that there cannot be so little a force in nature, but that giving it time enough, it will move the greatest weight that can be imagined: for the things we treat of, being all of them quantities; they may by division and multiplication, be brought unto equality. As for example; supposing the weight of a moveable, to be a million of pounds; and that the mover is able to move the millioneth part of one of those pounds, in a million of years, the millioneth part of a pace, through a medium of a certain rarity. Now, seeing that years may be multiplied so, as to equalize the force of this mover, unto the weight of the moveable: it followeth clearly that in so many millions of years, this force may move the whole weight of a million of pounds, through the determined medium in a determinate number of millions of years, a million of paces: for such a force is equall to the required effect; and by consequence, if the effect should not follow, there would be a compleat cause put, and no effect result from it.

But peradventure it is needfull to illustrate this point yet further: suppose then a weight never so great to be A, and a force never so little to be B. Now if you conceive that some other force moveth A, you must withall conceive that it moveth A some space, since all motion implieth necessarily that it be through some space: let that space be CD. And because a body cannot be moved in a space in an instant, but requireth some time to have its motion performed in; it followeth, that there must be a determined time, in which the conceived force must move the weight A through the space CD: let that time be EF. Now then, this is evident that it is all one to say that B moveth A, and to say that B moveth A through a space in a time; so that if any part of this be left out, it cannot be understood that B moveth A. Therefore to expresse particularly the effect which B is to do upon A, we must say that B must move A a certain

space in a certain time. Which being so, we may in the next place consider that this effect of moving A may be diminished 2 waies, either because the space it is to be moved in, is lessened; or the time taken up in its motion, is encreased: for, as it is a greater effect, to move A through the space CD, in a lesse time then EF, so it is a lesse effect to move the same A, through the space CD, in a greater time then EF; or through a lesse space then CD in the time EF. Now then, this being supposed, that it is a lesse effect to move A through CD, in a greater time then EF, it followeth also, that a lesser virtue is able to move it through CD in a greater time then EF, then the virtue which is required to move it, through the same space in the time EF. Which if it be once granted (as it cannot be denied) then multiplying the time, as much as the virtue or force required to move A through CD in the time EF is greater then the force B; in so much time, the force B will be able to move A through CD. Which discourse is evident, if we take it in the common terms: but if it be applied to action, wherein physicall accidents intervene, the artificer must have the judgement to provide for them, according to the nature of his matter.

5. The chief principle of Mechanicks deduced out of the former discourse.

Upon this last discourse doth hang the principle which governeth Mechanicks, to wit, that the force and the distance of weights counterpoysing one another, ought to be reciprocall. That is, that by how much the one weight is heavier then the other, by so much must the distance of the lighter from the fixed point upon which they are moved, be greater then the distance of the greater weight from the same point: for it is plain that the weight which is more distant, must be moved a greater space then the nearer weight in the proportion of the two distances. Wherefore the force moving it must carry it in a velocity of the said proportion to the velocity of the other. And consequently, the Agent, or mover, must be in that proportion more powerfull then the contrary mover. And out of this practise of Geometricians in Mechanicks (which is confirmed by experience) it is made evident that if other conditions be equall, the excesse of so much gravity will make so much velocity. And so much velocity in proportion, wil recompence so much gravity

6. No moveable can passe from

Out of the precedent conclusions, another followeth: which is, that nothing recedeth from quiet or rest, and attaineth a great degree

degree of celerity, but it muſt paſſe through all the degrees of celerity that are below the obtained degree. And the like is, in paſſing from any leſſer degree of velocity unto a greater: becauſe it muſt paſſe through all the intermediate degrees of velocity. For by the declaration of velocity, which we have even now made, we ſee that there is as much reſiſtance in the medium to be overcome with ſpeed, as there is for it to be overcome in regard of the quantity; or line of extent of it: becauſe (as we have ſaid) the force of the Agent in counterpoiſes, ought to be encreaſed as much as the line of extent of the medium, which is to be overcome by the Agent in equall time, doth exceed the line of extent of the medium, along which the reſiſtant body is to be moved. Wherefore it being proved that no line of extent can be overcome in an inſtant, it followeth, that no defect of velocity which requireth as great a ſuperproportion in the cauſe, can be overcome likewiſe in an inſtant.

reſt to any determinate degree of velocity, or from a leſſer degree to a greater, without paſſing through all the intermediate degrees, which are below the obtained degree

And by the ſame reaſon by which we prove that a moveable cannot be drawn in an inſtant from a lower degree of velocity to a higher, it is with no leſſe evidence concluded that no degree of velocity can be attained in an inſtant: for divide that degree of velocity into two halfs, and if the Agent had overcome the one halfe, he could not overcome the other half in an inſtant: much leſſe therefore is he able to overcome the whole (that is, to reduce the moveable from quiet to the ſaid degree of velocity) in an inſtant.

Another reaſon may be, becauſe the movers themſelves (ſuch movers as we treat of here) are bodies likewiſe moved, and do conſiſt of parts: whereof not every one part, but a competent number of them, doth make the moving body to be a fit Agent able to move the propoſed body in a propoſed degree of celerity. Now this Agent meeting with reſiſtance in the moveable, and not being in the utmoſt extremity of denſity, but condenſable yet further, (becauſe it is a body;) and that every reſiſtance (be it never ſo ſmall) doth work ſomething upon the mover (though never ſo hard) to condenſe it; the parts of the mover that are to overcome this reſiſtance in the moveable, muſt (to work that effect) be condenſed and brought together as cloſe as is needfull, by this reſiſtance of the moveable to the mo-

mover : and so, the remote parts of the mover, become nearer to the moveable, which cannot be done but successively, because it includeth locall motion. And this application being likewise divisible, and not all the parts flocking together in an instant to the place where they are to exercise their power; it followeth, that whiles there are fewer moving parts knit together, they must needs move lesse and more weakly, then when more or all of them are assembled and applied to that work. So that, the motive virtue encreasing thus in proportion to the multiplying of the parts applied to cause the motion ; of necessity, the effect (which is obedience to be moved, and quickness of motion in the moveable) must do so too: that is, it must from nothing, or from rest, passe through all the degrees of celerity untill it arrive to that which all the parts together are able to cause.

As for example, when with my hand I strike a ball ; till my hand toucheth it, it is in quiet; but then it beginneth to move; yet with such resistance, that although it obey in some measure the stroke of my hand, nevertheless it presseth the yielding flesh of my palm backwards towards the upper and bony part of it. That part then overtaking the other, by the continued motion of my hand ; and both of them joyning together to force the ball away ; the impulse becometh stronger, then at the first touching of it. And the longer it presseth upon it, the more the parts of my hand do condense and unite themselves to exercise their force; and the ball therefore must yield the more ; and consequently the motion of it groweth quicker and quicker, till my hand parteth from it. Which condensation of the parts of my hand encreasing successively by the parts joyning closer to one another, the velocity of the balls motion (which is an effect of it) must also encrease proportionably thereunto. And in like manner the motion of my hand and arm, must grow quicker and quicker and passe all the degrees of velocity between rest and the utmost degree it attaineth unto : for seeing they are the spirits swelling the nerves, that cause the arms motion, (as we shall hereafter shew ; ) upon its resistance, they flock from other parts of the body to overcome that resistance. And since their journey thither requireth time to perform it in ; and that the neareſt come first ; it must needs follow, that as they grow more and more in number , they must more

power-

powerfully overcome the resistance; and consequently, encrease the velocity of the motion, in the same proportion as they flock thither; untill it attain that degree of velocity, which is the utmost period that the power, which the Agent hath to overcome the resistance of the medium can bring it self unto. Between which and rest, or any other inferiour degree of velocitie, there may be designed infinite intermediate degrees, proportionable to the infinite divisibility of time, and space, in which the mover doth move. Which degrees do arise out of the reciprocall yielding of the medium. And that is likewise divisible in the same infinite proportion.

Since then, the power of all naturall Agents is limited; the mover (be it never so powerfull) must be confined to observe these proportions; and cannot passe over all these infinite designable degrees in an instant; but must allot some time (which hath a like infinity of designable parts) to ballance this infinity of degrees of velocity: and so consequently, it requireth time, to attain unto any determinate degree. And therefore cannot recede immediately from rest unto any degree of celerity, but must necessarily passe through all the intermediate ones.

Thus it is evident that all motion which hath a beginning must of necessity increase for some time. And since the works of nature are in proportion to their causes, it followeth that this encrease is in a determinate proportion. Which Galileus (unto whom we owe the greatest part of what is known concerning motion) teacheth us how to find out; and to discover what degree of celerity any moveable that is moved by nature, hath in any determinate part of the space it moveth in.

Having settled these conditions of motion; we shall do well in the next place to enquire after the causes of it: as well in the body moved, as also in the mover that occasioneth the motion. And because we have already shewed, that locall motion is nothing in substance but division: we may determine that those causes wch contribute to division, or resist it, are the causes which make or resist locall motion. It hath also been said, that Density hath in it a power of dividing: and that Rarity is the cause of being divided; likwise we have said that fire by reason of its smal parts, into wch it may be cut (which maketh them sharp) hath also an eminence in dividing: so that we have two qualities, density and tenuity

7. The conditions which help to motion, in the moveable are three; in the medium one.

Dialog. 1. of Motion.

or sharpnesse which concurre actively to division. We have told you also how Galileus hath demonstrated that a greater quantity of the same figure and density, hath a priviledge of descending faster then a lesser. And that priviledge consisteth in this, that the proportion of the superficies to the body it limiteth (which proportion the greater it is, the more it retardeth) is lesse in a greater bulk then in a smaller.

We have therefore three conditions concurring to make the motion more efficacious: namely, the density, the sharpnesse, and the bulk of the moveable. And more then these three, we cannot expect to find in a moved body: for quantity hath but three determinations: one, by density and rarity; of which, density is one of the three conditions: another, by its parts; as by a foot, a span, &c. and in this way we have found that the greater excelleth the lesser: the third and last, is by its figure; and in this we find that subtile or edged quantities do prevail over blunt ones. Seeing therefore, that these three determinations be all that are in quantity; there can be no more conditions in the body moved (which of necessity is a finite quantity) but the three named.

And as for the medium which is to be divided, there is onely rarity and density (the one, to help; the other, to hinder,) that require consideration on its side. For neither figure, nor littlenesse and greatnesse, do make any variation in it. And as for the Agent, it is not as yet time, before we have looked further into the nature of motion, to determine his qualities.

8. No body hath any intrinsecall virtue to move it self towards any determinate part of the universe.

Now then let us reflect how these three conditions do all agree in this circumstance, that they help nothing to division, unlesse the body in which they are, be moved and pressed against the body that is to be divided, so that we see no principle to perswade us, that any body can move it self towards any determinate part or place of the universe, of its owne intrinsecall inclination. For besides that the learned Author of the Dialogues de Mundo (in his third Dialogue, and the second knot) hath demonstrated that a body cannot move unlesse it be moved by some extrinsecall Agent; we may easily frame unto our selves a conceit, of how absurd it is to think that a body by a quality in it can work upon it self: as if we should say, that rarity (which is but more quantity) could work upon quantity; or that figure (which is but that the body reacheth no further) could work upon

upon the body: and in generall, that the manner of any thing can work upon that thing whose manner it is. For Aristotle and Saint Thomas, and their intelligent commentatours, declaring the notion of *Quality*, tell us, that *to be a Quality* is nothing else but to be the determination or modification of the thing whose quality it is.

Besides, that the naturall manner of operation is, to work according to the capacity of the subject: but when a body is in the midst of an uniform medium or space, the subject is equally prepared on all sides to receive the action of that body. Wherefore (though we should allow it a force to move) if it be a naturall Agent, and have no understanding, it must work indifferently on all sides, and by consequence, cannot move on any side. For if you say that the Agent in this case (where the medium is uniform) worketh rather upon on side then upon another; it must be because this determination is within the Agent it self, and not out of the circumstant dispositions: which is the manner of working of those substances that work for an end of their own; that is, of understanding creatures, and not of naturall bodies.

9. The increase of motion is alwayes made in the proportion of the odde numbers.

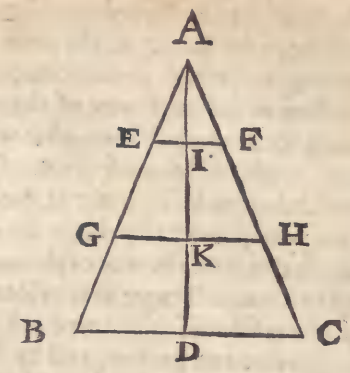
Now he that would exactly determine what motion a body hath, or is apt to have; determining by supposition the force of the Agent, must calculate the proportions of all these three conditions of the moveable, and the quality of the medium: which is a proceeding too particular for the intention of our discourse. But to speak in common, it will not be amisse to examine in what proportion, motion doth increase; since we have concluded that all motion proceedeth from quiet by a continuall encrease. Galileus (that miracle of our age, and whose wit was able to discover whatsoever he had a mind to employ it about) hath told us that naturall motion encreaseth in the proportion of the odde numbers. Which to expresse by example, is thus: suppose that in the going of the first yard it hath one degree of velocity, then in the going of the second yard it will have three degrees, and in going of the third it will have five: and so onwards, still adding two to the degrees of the velocity for every one, to the space. Or to expresse it more plainly; if in the first minute of time it goeth one yard of space, then in the next minute it will go three yards, in the third it will go five, in the fourth seaven, and so forth.

But we must enlarge this proposition unto all motions, as we have done the former, of the encrease it self in velocity: because the reason of it is common to all motions. Which is, that all motion (as may appear out of what we have formerly said) proceedeth from two causes; namely, the Agent or the force that moveth, and the disposition of the body moved, as it is composed of the three qualities we lately explicated. In which is to be noted, that the Agent doth not move simply by its own virtue, but it applyeth also the virtue of the body moved, which it hath to divide the medium when it is put on. As when we cut with a knife, the effect proceedeth from the knife pressed on by the hand; or from the hand as applying and putting in action the edge and cutting power of the knife. Now this in Physicks and Nature is clearly parallel to what in Geometry and Arithmetick the Mathematicians call, drawing one number or one side into another; for as in Mathematicks, to draw one number into another is to apply the number drawn unto every part of the number into which it is drawn; as if we draw three into seven we make twenty one, by making every unity or part of the number seven to be three: and the like is of lines in Geometry. So in the present case, to every part of the hands motion, we adde the whole virtue of the cutting faculty which is in the knife; and to every part of the motion of the knife, we adde the whole pressing virtue of the hand. Therefore the encrease of the effect proceeding from two causes so working must also be parallel to the encrease of the quantities arising out of the like drawing in Mathematicks. But in those, it is evident that the encrease is according to the order of the odde numbers, and therefore it must in our case be the like: that is, the encrease must be in the said proportion of odde numbers. Now that in those the encrease proceedeth so will be evident, if you consider the encrease of an Equicrure triangle; which because it goeth upon a certain proportion of length and breadth, if you compare the encreases of the whole triangle (that gaineth on each side) with the encreases of the perpendicular (which gaineth onely in length) you will see that they still proceed in the foresaid proportion of odde numbers.

Which will be better understood, if we set down the demonstration of it: let the Equicrure triangle be A B C: and from the

point:

point A, draw the line A D perpendicular to the line B C, & let it be divided into three equall parts by the lines E F and G H, in the points I and K. And I ſay that becauſe the line A K is twice as long as the line A I, therefore the trapezium E F H G, is thrice as big as the triangle A E F: for as A K is to A I, ſo is G H to E F. But the triangle A G H




is to the triangle A E F, in a double proportion of the line G H to the line E F: which being double the proportion of one triangle to the other muſt be fourefold: ſo that ſubtracting the triangle AEF, the trapezium E F HG remaineth thrice as big as it. And thus the whole triangle getteth an encreaſe of three, whiles the perpendicular is encreaſed but one, to make his length two. Which when it cometh to three, the trapezium GHCB that containeth the third diviſion of the perpendicular, becometh five times as big as the triangle AEF; for ſince the line A D is three times as long as the line A I; and the line B C is three times as long as E F; it followerh that the triangle ABC is nine times as big as the triangle AEF; but AGH is foure times as big as AEF; therefore ſubtracting it from the whole triangle ABC, it leaveth the trapezium GHCB five times as big as the firſt triangle AEF. Which propoſition is very ingeniouſly ſet down by the learned Monſieur Gaſſendi in his firſt Epiſtle *de motu impreſſo a motore tranſlato*, to the ſame purpoſe for which we bring it. Though we do not here make uſe of his ſcheme and way of demonſtration; becauſe we had fallen upon this before his book came abroad: and therefore we onely note his to direct the Reader unto it, who peradventure may like his better then ours. Howbeit we do not conceive that he hath in his diſcourſe there, arrived to the true reaſon of the effect we ſearch into: as may appear by what we have already delivered.

But we muſt not imagine, that the velocity of motion will alwayes encreaſe thus for as long as we can fancy any motion; but when it is arrived unto the utmoſt period that ſuch a moveable with ſuch cauſes is capable of, then it keepeth conſtantly the-

10. No motion can encreaſe for ever without coming to a period.

the same pace, and goeth equally and uniformly at the same rate. For since the density of the moveable, and the force of the Agent moving it, (which two do cause the motion) have a limited proportion to the resistance of the medium, how yielding soever it be; it must needs follow, that when the motion is arrived unto that height which ariseth out of this proportion, it cannot exceed it, but must continue at that rate, unless some other cause give yet a greater impulse to the moveable. For velocity consisting in this, that the moveable cutteth through more of the medium in an equall time; it is evident that in the encrease of velocity, the resistance of the medium which is overcome by it, groweth greater and greater, and by little and little gaineth upon the force of the Agent; so that the superproportion of the Agent, groweth still lesser and lesser as the velocity encreaseth: and therefore at the length they must come to be ballanced. And then the velocity can encrease no more.

And the reason of the encrease of it for a while at the beginning, is because that coming from rest, it must passe through all the intermediate degrees of velocity before it can attain to the height of it, which requireth time to perform, and therefore falleth under the power of our sense to observe. But because we see it do so for some time, we must not therefore conclude that the nature of such motion is still to encrease without any period or limit; like those lines that perpetually grow nearer, and yet can never meet: for we see that our reason examining the causes of this velocity, assureth us that in continuance of time and space, it may come to its height which it cannot exceed.

And there, would be the pitch at which distance weights being let fall, would give the greatest strokes and make greatest impressions. It is true that Galileus and Mersenius (two exact experimenters) do think they find this verity by their experiences. But surely that is impossible to be done: for the encrease of velocity being in a proportion ever diminishing, it must of necessity come to an insensible encrease in proportion before it endeth: for the space which the moveable goeth through is still encreased; and the time wherein it passeth through that space remaineth still the same little one as was taken up in passing a lesse space immediately before; and such little differences of great spaces passed over in a little time come soon to be undiscernable by sense. But reason (which sheweth us, that if velocity never ceased from

from encreasing, it would in time arrive to exceed any particular velocity; and by consequence, the proportion which the mover hath to the medium: because of the adding still a determinate part to its velocity) concluding plainly that it is impossible, motion should increase for ever, without coming to a period.

II. Certain problems resolved concerning the proportion of some moving Agents compared to their effects.

Now the impression which falling weights do make, is of two kinds; for the body into which impression is made, either can yield backward, or it cannot. If it can yield backward, then the impression made is a motion: as we see a stroke with a racket upon a ball, or with a pail-mail beetle upon a bowl maketh it flie from it. But if the strucken body cannot yield backwards, then it maketh it yield on the sides. And this, in divers manners: for if the smitten body be drie and brittle, it is subject to break it, and make the peices flie round about: but if it be a tough body, it squeeseth it into a larger form.

But because the effect in any of these wayes is eminently greater then the force of the Agent seemeth to be; it is worth our labour to look into the causes of it. To which end we may remember how we have already declared that the force of the velocity is equall to a reciprocall force of weight in the virtue movent: wherefore the effect of a blow that a man giveth with a hammer, dependeth upon the weight of the hammer, upon the velocity of the motion, and upon the hand, in case the hand accompanieth the blow. But if the motion of the hand ceaseth before (as when we throw a thing) then onely the velocity and the weight of the hammer remain to be considered. Howsoever, let us put the hand and weight in one summe which we may equalize by some other virtue or weight. Then let us consider the way or space, which a weight lying upon the thing is to go forwards to do the same effect in the same time as the percussion doth. And what excesse the line of the blow, hath over the line of that way or space; such an excesse we must adde of equall weight or force, to the weight we had already taken. And the weight composed of both, will be a fit Agent to make the like impression. This Probleme was proposed unto me by that worthy religious man, Father Mersenius: who is not content with advancing learning by his own industry and labours; but besides, is alwayes (out of his generous affection to verity) inciting others to contribute to the publick stock of it.

He proposed to me likewise this following question, to wit, why

why there is required a weight of water in double Geometricall proportion, to make a pipe run twice as fast as it did, or to have twice as much water run out in the same time? Unto which I answer out of the same ground as before: That because in running twice as fast, there goeth out double water in every part of time; and again, every part of water goeth a double space in the same part of time; that is to say, because double the celerity is drawn into double the water, and double the water into double the celerity; therefore the present effect is to the former effect, as the effect or quadrate of a double line drawn into it self, is to the effect or quadrate of half the said line drawn into it self. And consequently the cause of the latter effect (which is the weight then) must be to the cause of the former effect (that is, to the former weight) in the same proportion; namely, as the quadrate of a double line, is to the quadrate of half that line. And so you see the reason of what he by experience findeth to be true. Though I doubt not but when he shall set out the Treatise which he hath made of this subject, the Reader will have better satisfaction.

In the mean while, an experience which Galileo delivereth will confirm this doctrine. He saith, that to make the same pendant go twice as fast as it did, or to make every undulation of it in half the time it did; you must make the line at which it hangeth, double in Geometricall proportion to the line at which it hanged before. Whence it followeth, that the circle by which it goeth is likewise in double Geometricall proportion. And this being certain, that celerity to celerity hath the proportion of force, which weight hath to weight; it is evident, that as in one case there must be weight in Geometricall proportion; so in the other case, where onely celerity maketh the variance, the celerity must be in double Gemetricall proportion, according as Galileo findeth it by experience.

But to return to our main intent, there is to be further noted, that if the subject strucken be of a proportionate cessibility, it seemeth to dull and deaden the stroke: whereas, if the thing strucken be hard, the stroke seemeth to lose no force, but to work a greater effect. Though indeed the truth be, that in both cases the effects are equall; but diverse according to the natures of the things that are strucken; for no force that once is in nature can be lost, but must have its adequate effect one way or other.

Let

Let us then first suppose the body strucken to be a hard body of no exceeding bigness: in which case, if the stroke light perpendicularly upon it, it will carry such a body before it. But if the body be too great, and have its parts so conjoyned, as that they are weaker then the stroke; in this case the stroke driveth one part before it, and so breaketh it from the rest. But lastly, if the parts of the strucken body be so easily cessible, as without difficulty the stroke can divide them, then it entereth into such a body untill it hath spent its force. So that now making up our account, we see that an equall effect proceedeth from an equall force in all the three cases; though in themselves they be far different. But we are apt to account that effect greater, which is more considerable unto us by the profit or damage it bringeth us. And therefore we usually say, that the blow which shaketh a wall, or beateth it down, and killeth men with the stones it scattereth abroad; hath a greater effect then that which penetrateth far into a mud wall, and doth little harm: for that innocuousnesse of the effect, maketh that although in it self it be as great as the other, yet it is little observed or considered.

This discourse draweth on another: which is to declare how motion ceaseth. And to summe that up in short, we say that when motion cometh unto rest, it decreaseth & passeth through all the degrees of celerity and tardity that are between rest and the height of that motion which so declineth: and that in the proportion of the odde numbers, as we declared above, that it did encrease. The reason is clear: because that which maketh a motion cease, is the resistance it findeth: which resistance is an action of a mover that moveth something against the body which is moved, or something equivalent to such an action: wherefore it must follow the laws that are common to all motions: of which kind those two are that we have expressed in this conclusion. Now that resistance is a countermotion, or equivalent to one, is plain by this; that any body which is pressed must needs presse again upon the body that presseth it; wherefore the cause that hindereth such a body from yielding, is a force moving that body against the body which presseth it. The particulars of all which we shall more at large declare, where we speak of the action and reaction of particular bodies.

**12.** When a moveable cometh to rest, the motion doth decrease according to the rules of encrease.

CHAP.

## CHAP. X.

### *Of Gravity and Levity; and of Locall Motion, commonly termed Naturall.*

1. Those motions are called naturall which have constant causes, & those violent which are contrary to them.

IT is now time to consider that distinction of motions which is so famous in Aristotle; to wit, that some motions are naturall, others violent: and to determine what may be signified by these terms. For seeing we have said that no body hath a naturall intrinsecall inclination unto any place, to which it is able to move it self; we must needs conclude that the motion of every body followeth the percussion of extrinsecall Agents. It seemeth therefore impossible that any body should have any motion naturall to it self. And if there be none naturall, there can be none violent. And so this distinction will vanish to nothing. But on the other side, living creatures do manifestly shew naturall motions, having naturall instruments to perform certain motions: wherefore such motions must of necessity be naturall to them. But these are not the motions which we are to speak of; for Aristotles division is common to all bodies, or at the least to all those we converse withall: and particularly to those which are called heavy and light; which two terms passe through all the bodies we have notice of.

Therefore proceeding upon our grounds before layed; to wit, that no body can be moved of it self; we may determine those motions to be naturall unto bodies which have constant causes, or percutients to make them alwayes in such bodies: and those violent which are contrary to such naturall motions. Which being supposed, we must search out the causes that so constantly make some bodies descend towards the center or middle of the earth; and others to rise and go from the center: by which the world is subject to those restlesse motions, that keep all things in perpetuall flux, in this changing sphere of action and passion.

2. The first and most generall operation of the sunne, is the making and raising of atomes.

Let us then begin with considering what effects the sunne (which is a constant and perpetuall cause) worketh upon inferiour bodies, by his being regularly sometimes present and sometimes absent. Observe in a pot of water hanging over a fire, how the heat maketh some parts of the water to ascend, and others to supply the room by descending, so that

that as long as it boyleth, it is in a perpetuall confused motion up and down. Now having formerly concluded that *fire is light, and light is fire*; it cannot be doubted but that the sunne doth serve in stead of fire to our globe of earth and water, (which may be fitly compared to the boyling pot;) and all the day long draweth vapours from those bodies that his beams strike upon. For he shooting his little darts of fire in multitudes, and in continued streams from his own center against the Python the earth we live on; they do there overtake one another, and cause some degree of heat as farre as they sink in. But not being able (by reason of their great expansion in their long journey) to convert it into their own nature and set it on fire, (which requireth a high degree of condensation of the beams) they do but pierce & divide it very subtilly, and cut some of the outward parts of it into extreme little atomes. Unto which they sticking very close, and being in a manner incorporated with them (by reason of the moysture that is in them) they do in their rebound back from the earth carry them along with them; like a ball that struck against a moist wall, doth in its return from it, bring back some of the mortar sticking upon it. For the distance of the earth from the sun is not the utmost period of these nimble bodies flight; so that when by this solid body they are stopped in their course forwards on, they leap back from it, and carry some little parts of it with them: some of them a farther, some of them a shorter journey; according as their littlenesse and rarity make them fit to ascend. As is manifest by the consent of all Authours that write of the regions of the aire; who determine the lower region to reach as farre as the reflection of the sunne; and conclude this region to be very hot.

For if we mark how the heat of fire is greatest, when it is incorporated in some dense body; (as in iron or in sea-coal) we shall easily conceive that the heat of this region proceedeth mainly out of the incorporation of light with those little bodies which stick to it in its reflexion. And experience testifieth the same, both in our soultry dayes, which we see are of a grosse temper, and ordinarily go before rain: as also in the hot springs of extreme cold countreys, where the first heats are unsufferable; which proceed out of the resolution of humidity congealed; & in

hot

in hot winds (which the Spaniards call *Bochornos* from Boca de horno by allusion to the breathing steam of an oven when it is opened) which do manifestly shew that the heat of the sunne is incorporated in the little bodies, which compose the steam of that wind. And by the principles we have already layed, the same would be evident; though we had no experience to instruct us; for seeing that the body of fire is dry, the wet parts (which are easiest resolved by fire) must needs stick unto them, and accompany them in their return from the earth.

3. The light rebounding from the earth with atomes, causeth two streams in the aire; the one ascending the other descending; and both of them in a perpendicular line.

Now whiles these ascend, the aire must needs cause others that are of a grosser complexion to descend as fast, to make room for the former, and to fill the places they left, that there may be no vacuity in nature. And to find what parts they are and from whence they come, that succeed in the room of light and atomes glewed together that thus ascend; we may take a hint from the maxime of the Opticks, that light reflecting maketh equall angles; whence, supposing the superficies of the earth to be circular, it will follow that a perpendicular to the center passeth just in the middle between the two rayes; the incident and the reflected. Wherefore the aire between these two rayes, and such bodies as are in it being equally pressed on both sides; those bodies which are just in the middle, are neareſt and likeliest to succeed immediately in the room of the light and atomes which ascend from the superficies of the earth: and their motion to that point is upon the perpendicular. Hence it is evident, that the aire and all such bodies as descend to supply the place of light and atomes, which ascend from the earth, do descend perpendicularly towards the center of the earth.

And again, such bodies as by the force of light being cut from the earth or water, do not ascend in form of light, but do incorporate a hidden light and heat within them; (and thereby are rarer then these descending bodies) must of necessity be lifted up by the descent of those denser bodies that go downwards, because they (by reason of their density) are moved with a greater force. And this lifting up must be in a perpendicular line; because the others descending on all sides perpendicularly, must needs raise those that are between them equally

equally from all sides: that is, perpendicularly from the center of the earth. And thus we see a motion set on foot, of some bodies continually descending, and others continually ascending: all in perpendicular lines, excepting those which follow the course of lights reflexion.

Again as soon as the declining sun groweth weaker or leaveth our horizon, and that his beams vanishing do leave the little horsemen which rode upon them, to their owne temper and nature (from whence they forced them) they finding themselves surrounded by a smart descending stream, do tumble down again in the night, as fast as in the day they were carried up; and crowding into their former habitations, they exclude those that they find had usurped them in their absence. And thus, all bodies within reach of the sunnes power, but especially our aire, are in perpetuall motion; the more rarified ones ascending, and the dense ones descending.

4. A dense body placed in the aire between the ascending and descending stream, must needs descend.

Now then; because no bodies whereseoever they be (as we have already shewed) have any inclination to move towards a particular place, otherwise then as they are directed and impelled by extrinsecall Agents: let us suppose that a body were placed at liberty in the open aire. And then casting whether it would be moved from the place we suppose it in: and which way it would be moved; we shall find that it must of necessity happen that it shall descend and fall down till it meet with some other grosse body to stay and support it. For although of it self it would move no way: yet if we find that any other body striketh efficaciously enough upon it; we cannot doubt but that it will move that way which the striking body impelleth it. Now, it is strucken upon on both sides (above and below) by the ascending, and the descending atomes, the rare ones, striking upon the bottome of it, and driving it upwards, and the denser ones, pressing upon the top of it and bearing it downwards. But if you compare the impressions that the denser atomes make, with those that proceed from the rare ones; it is evident that the dense ones must be the more powerfull; and therefore will assuredly determine the motion of the body in the aire, that way they go, which is downwards.

Nor need we fear, lest the littlenesse of the agents, or the feebleness of their strokes, should not be sufficient to work this

effect; since there is no resistance in the body it self, and the aire is continually cut in pieces, by the sunne beams, and by the motions of little bodies; so that the adhesion unto aire of the body to be moved, will be no hinderance to this motion: especially, considering the perpetuall new percussions, and the multitude of them, and how no force is so little, but that with time and multiplication it will overcome any resistance.

5. A more particular explication of all the former doctrine touching gravitie.

But if any man desireth to look upon, as it were at one view; the whole chain of this doctrine of gravity: let him turn the first cast of his eyes upon what we have said of fire when we explicated the nature of it. To wit, that it beginneth from a little source; and by extreme multiplication and rarefaction, it extendeth it self into a great sphere. And then he will perceive the reason why light is darted from the body of the sunne with that incredible celerity, wherewith its beams fly to visite the remotest parts of the world; and how of necessity, it giveth motion to all circumstant bodies; since it is violently thrust forward by so extreme a rarefaction; and the further it goeth, is still the more rarified and dilated.

Next, let him reflect how infinitely the quickness of lights motion, doth prevent the motion of a moist body, such an one as aire is: and then he will plainly see, that the first motion which light is able to give unto the aire, must needs be a swelling of that moist element, perpendicularly round about the earth; for, the ray descendent, and the ray reflectent, flying with so great a speed, that the aire between them cannot take a formall ply any way before the beams of light be on both sides of it: it followeth, that according to the nature of humide things, it must first onely swell: for that is the beginning of motion in them, when heat entereth into them, and worketh upon them. And thus he may confidently resolve himself, that the first motion which light causeth in the aire, will be a swelling of it between the two rayes towards the middle of them. That is; perpendicularly from the surface of the earth.

And out of this, he will likewise plainly see, that if there be any other little dense bodies floating in the aire, they must likewise mount a little, through this swelling and rising of the aire. But that mounting will be no more then the immediate parts of the aire themselves do move. Because this motion is not by way

of

of impulse or stroke that the aire giveth those denser bodies; but by way of containing them in it, and carrying them with it, so that it giveth them no more celerity, then to make them go with it self, and as parts of it self.

Then, let him consider, that light or fire, by much beating upon the earth, divideth some little parts of it from others: whereof if any do become so small and tractable, as not to exceed the strength which the rayes have to manage them; the returning rayes, will at their going back, carry away with them or drive before them, such little atomes as they have made or meet with: & so fill the aire with little bodies cut out of the earth.

After this, let him consider that when light carrieth up an atome with it, the light and the atome do stick together, and do make one ascending body; in such sort as when an empty dish lyeth upon the water, the aire in the dish maketh one descendent body together with the dish it self: so that the density of the whole body of aire and dish (which in this case, are but as one body) is to be esteemed according to the density of the two parts; one of them being allayed by the other, as if the whole were throughout of such a proportion of density, as would arise out of the composition and kneading together the severall densities of those two parts. Now then, when these little compounded bodies of light and earth, are carried up to a determinate height; the parts of fire or light, do by little and little break away from them: and thereby, the bulk of the part which is left, becometh of a different degree of density (quantity for quantity) from the bulk of the entire atome, when light was part of it: and consequently it is denser then it was.

Besides, let him consider that when these bodies ascend; they do go from a narrow room to a large one, that is, from the centerwards to the circumference: but when they come down again, they go from a larger part to a narrower. Whence it followeth, that as they descend, they draw closer and closer together, and by consequence, are subject to meet and to fall in one with another; and thereby to increase their bulk, and to become more powerfull in density; not onely, by the losse of their fire; but also by the encrease of their quantity. And so it is evident, that they are denser coming down, then going up.

Lastly, let him consider, that those atomes which went up first,

and are parted from their volatile companions of fire or light, must begin to come down apace, when other new atomes (which still have their light incorporated with them) do ascend to where they are, and do go beyond them by reason of their greater levity. And as the latter atomes come up with a violence and a great celerity, so must the first go down with a smart impulse: and by consequence, being more dense then the aire in which they are carryed, must of necessity cut their way through that liquid and rare medium; and go the next way to supply the defect and room of the atomes which ascend; (that is, perpendicularly to the earth) and give the like motion to any body they find in their way, if it be susceptible of such a motion: whichit is evident that all bodies are, unlesse they be strucken by some contrary impulse. For since that a bodies being in a *place*, is nothing else but the continuity of its outside to the inside of the body that containeth it and is its place, it can have no other repugnance to locall motion (which is nothing else but a successive changing of place) besides this continuity. Now the nature of density, being the power of dividing; and every least power having some force and efficacy, (as we have shewed above) it followeth that the stroke of every atome (either descending, or ascending) will work something upon any body (though never so big) it chanceth to incounter with, and strike upon in its way, unlesse there be as strong an impulse the contrary way, to oppose it. But it being determined, that the descending atomes are denser then those that ascend; it followeth that the descending ones will prevail. And consequently, all dense bodies must necessarily tend downwards, to the center (which is, to be *Heavy*) if some other more dense body do not hinder them.

*6.*

Gravity and levity do not signifie an intrinsecall inclination to such a motion in the bodies themselves which are termed heavy and light.

Out of this discourse, we may conclude that there is no such thing among bodies, as positive gravity or levity: but that their course upwards or downwards happeneth unto them by the order of nature, which by outward causes giveth them an impulse one of these wayes: without which, they would rest quietly whersoever they are, as being of themselves indifferent to any motion. But because our words expresse our notions, and they are framed according to what appeareth unto us; when we observe any body to descend constantly towards our earth, we call it heavy; and if it move contrarywise, we call it light.

But

But we muſt take heed of conſidering ſuch gravity and levity as if they were Entities that work ſuch effects: ſince upon examination, it appeareth that theſe words are but ſhort expreſſions of the effects themſelves: the cauſes whereof, the vulgar of mankind (who impoſe names to things) do not conſider; but leave that work unto Philoſophers to examine; whiles they onely obſerve, what they ſee done; and agree upon words to expreſſe that. Which words neither will in all circumſtances alwayes agree to the ſame thing; for as cork doth deſcend in aire and aſcend in water; ſo alſo will any other body deſcend if it lighteth among others more rare then it ſelf, and will aſcend if it lighteth among bodies that are more denſe then it. And we term bodies light and heavy, onely according to the courſe, which we uſually ſee them take.

Now proceeding further on; and conſidering how there are various degrees of denſity or gravity: it were irrationall to conceive, that all bodies ſhould deſcend at the ſame rate, and keep equall pace with one another, in their journey downwards. For as two knifes whereof one hath a keener edge then the other, being preſſed with equall ſtrength into like yielding matter, the ſharper will cut deeper then the other: ſo, if of two bodies one be more denſe then the other; that which is ſo, will cut the aire more powerfully, and will deſcend faſter then the other: for in this caſe denſity may be compared to the knifes edge, ſince in it conſiſteth the power of dividing; as we have heretofore determined. And therefore, the preſſing them downwards by the deſcending atomes, being equall in both (or peradventure greater in the more denſe body; as anon we ſhall have occaſion to touch) and there being no other cauſe to determine them that way; the effect of diviſion muſt be the greater, where the divider is the more powerfull. Which, the more denſe body is; and therefore cutteth more ſtrongly through the reſiſtance of the aire; and conſequently, paſſeth more ſwiftly that way it is determined to move.

7. The more denſe a body is, the more ſwiftly it deſcendeth.

I do not mean, that the velocities of their deſcent ſhall be in the ſame proportion to one another, as their denſities are: for beſides their denſity, thoſe other conſiderations which we have diſcourſed of above when we examined the cauſes of velocity in motion, muſt likewiſe be ballanced. And out of the com-

8. The velocity of bodies deſcending, doth not encreaſe in proportion to the difference that maybe between their ſeverall denſities.

compariſon of all them; not out of the conſideration of any one alone, reſulteth the differences of their velocities: (and that neither, but in as much as concerneth the conſideration of the moveables: for to make the calculation exact, the medium muſt likewiſe be conſidered; as by and by we ſhall declare) for ſince the motion dependeth of all them together; although there ſhould be difference between the moveables in regard of one onely, and that the reſt were equall; yet the proportion of the difference of their motions, muſt not follow the proportion of their difference in that one regard: becauſe their difference conſidered ſingle in that regard will have one proportion; and with the addition of the other conſiderations (though alike in both) to their difference in this, they will have another.

As for example, reckon the denſity of one moveable to be double the denſity of another moveable; ſo that in that regard it hath two degrees of power to deſcend, whereas the other hath but one: ſuppoſe then the other cauſes of their deſcent to be alike in both, and reckon them all three: and then joyn theſe three to the one which is cauſed by the denſity in one of the moveables, as likewiſe to the two, which is cauſed by the denſity in the other moveable: and you will find that thus altogether, their difference of power to deſcend is no longer in a double proportion (as it would be, if nothing but their denſity were conſidered) but is in the proportion of five to foure.

But after we have conſidered all that concerneth the moveables, we are then to caſt an eye upon the medium they are to move in; and we ſhall find the addition of that, to decreaſe the proportion of their difference, exceedingly more; according to the ceſſibility of the medium. Which if it be aire; the great diſproportion of its weight, to the weight of thoſe bodies which men uſe to take in making experiences of their deſcent in that yielding medium; will cauſe their difference of velocity in deſcending, to be hardly perceptible. Even as the difference of a ſharp or dull knife, which is eaſily perceived in cutting of fleſh or bread, is not to be diſtinguiſhed in dividing of water or oyl. And likewiſe in weights, a pound and a ſcruple will bear down a dramme in no ſenſible proportion of velocity more then a pound alone would do: and yet put a pound in that ſcale in ſtead of the dramme, and then the

the difference of the scruple will be very notable. So then, those bodies, whose difference of descending in water is very sensible (because of the greater proportion of weight in water, to the bodies that descend in it) will yield no sensible difference of velocity when they descend in aire, by reason of the great disproportion of weight between aire & the bodies that descend in it

The reason of this will clearly shew it self in abstracted proportions. Thus; suppose aire to have one degree of density, and water to have 400; then let the moveable A have 410 degrees of density; and the moveable B have 500. Now compare their motion to one another in the severall mediums of aire and water. The exuperance of the density of A to water is 10 degrees, but the exuperance of B unto the same water, is 100 degrees; so that B must move in water swifter then A, in the proportion of 100 to tenne; that is, of 10 to one. Then let us compare the exuperance of the two moveables over aire. A is 409 times more dense then aire; but B is 499 times more dense then it. By which account, the motion of B, must be in that medium swifter then the motion of A, in the proportion of 499 to 409: that is, about 50, to 41: which (to avoid fractions) we may account as 10 to 8. But in water they exceed one another as 10 to one: so that their difference of velocity, must be scarce perceptible in aire in respect of what it is in water.

Out of all which discourse, I onely inferre in common, that a greater velocity in motion, will follow the greater density of the moveable; without determining here their proportions: which I leave unto them, who make that examination their task: for thus much serveth my present turn: wherein I take a survey of nature, but in grosse. And my chief drift in this particular is onely to open the way for the discovering how bodies that of themselves have no propension unto any determinate place; do nevertheless move constantly and perpetually one way; the dense ones descending, and the rare ones ascending: not by any intrinsecall quality that worketh upon them; but by the oeconomy of nature, that hath set on foot due and plain causes to produce known effects.

9. More or lesse gravity doth produce a swifter or a slower

Here we must crave patience of the great soul of Galileus (whose admirable learning all posterity must reverence) whiles we reprehend in him, that which we cannot term lesse then absurd:

descending of a heavy body. Aristotles argument to disprove motion *in vacuo*, is made good.

absurd: and yet, he not onely maintaineth it in severall places, but also professeth, Dial. Po. de motu pag. 81. to make it more clear then day. His position is, that more or lesse gravity contributeth nothing at all to the faster or slower descending of a naturall body: but that all the effect it giveth unto a body, is to make it descend or not descend in such a medium. Which is against the first and most known principle that is in bodies: to wit, that more doth more, and lesse doth lesse; for he alloweth, that gravity causeth a body to descend; and yet will not allow, that more gravity causeth it to descend more.

I wonder that he never marked how in a pair of scales, a superproportion of overweight in one ballance, lifted up the other faster then a lesse proportion of overweight would do. Or that more weight hanged to a jack, made the spit turn faster; or to the lines of a clock, made it go faster, and the like.

But his argument whereby he endeavoureth to prove his position, is yet more wonderfull: for finding in pendants unequall in gravity, that the lighter went in the same time almost as fast as the heavier; he gathereth from thence, that the different weights have each of them the same celerity: and that it is the opposition of the aire, which maketh the lighter body not reach so farre at each undulation, as the heavier doth. For reply whereunto; first, we must ask him whether experience or reason taught him, that the slower going of the lighter pendant, proceeded onely from the medium, and not from want of gravity? And when he shall have answered (as he needs must) that experience doth not shew this: then we must importune him for a good reason: but I do not find that he bringeth any at all.

Again; if he admitteth (which he doth in expresse terms) that a lighter body cannot resist the medium so much as a heavier body can, we must ask him, whether it be not the weight that maketh the heavier body resist more: which when he hath acknowledged that it is; he hath therein likewise acknowledged, that whensoever this happeneth in the descending of a body, the more weight must make the heavier body descend faster

But we cannot passe this matter without noting how himself maketh good those arguments of Aristotle, which he seemeth by no means to esteem of: for since the gravity doth overcome the resistance of the medium in some proportion; it followeth, that the

the proportions between the gravity and the medium, may be multiplied without end; so as, if he suppose that the gravity of a body do make it go at a certain rate in imaginary space, (which is his manner of putting the force of gravity,) then there may be given such a proportion of a heavy body to the medium, as it shall go in such a medium at the same rate; and nevertheless, there will be an infinite difference, betwixt the resistance of the medium compared to that body, and the resistance of the imaginary space compared to that other body which he supposeth to be moved in at the same rate: which no man will stick at confessing to be very absurd.

Then turning the scales, because the resistance of the medium doth somewhat hinder gravity, and that with less resistance, the heavy body moveth faster; it must follow, that since there is no proportion, betwixt the medium and imaginary space; there must neither be any proportion betwixt the time in which a heavy body shall passe through a certain quantity of the medium, & the time in which it shall passe through as much imaginary space: wherefore, it must passe over so much imaginary space in an instant. Which is the argument that Aristotle is so much laughed at for pressing. And in a word, nothing is more evident, then that, for this effect which Galileo attributeth to gravity, it is unreasonable to put a divisible quality, since the effect is indivisible. And therefore as evident it is that in his doctrine such equality, as intrinsecal gravity is conceived to be, ought not to be put: since every power should be fitted to the effect, or end for which it is put.

Another argument of Galileo is as bad as this; when he endeavoureth to prove that all bodies go of a like velocity, because it happeneth that a lighter body in some case, goeth faster then a heavier body in another case: as for example, in two pendants, whereof the lighter is in the beginning of its motion, and the heavier towards the end of it; or if the lighter hangeth at a longer string, and the heavier at a shorter; we see that the lighter will go faster then the heavier. But this concludeth no more, then if a man should prove that a lighter goeth faster then a heavier, because a greater force can make it go faster; for it is manifest that in a violent motion, the force which moveth a body in the end of its course, is weaker then that which moveth it in the beginning: and the like is, of the two strings. But

10. The reason why in the inferiour quarter of a circle, a body doth descend faster by the arch of that quarter, then by the chord of it.

But here it is not amisse to solve a Probleme he putteth which belongeth to our present subject. He findeth by experience, that if two bodies descend at the same time from the same point, and do go to the same point, the one by the inferiour quarter of the circle; the other by the chord to that arch, or by any other lines which are chords to parts of that arch: he findeth (I say) that the moveable goeth faster by the arch, then by any of the chords. And the reason is evident, if we consider that the nearer any motion doth come unto a perpendicular one downwards, the greater velocity it must have: and that in the arch of such a quadrant, every particular part of it inclineth to the perpendicular of the place where it is, more then the part of the chord answerable unto it doth.

## CHAP. XI.

*An answer to objections against the causes of naturall motion, avowed in the former chapter; and a refutation of the contrary opinion.*

1. The first objection answered; why a hollow body descendeth slower then a solid one.

But to return to the thrid of our doctrine; there may peradventure be objected against it, that if the violence of a bodies descent towards the center, did proceed onely from the density of it (which giveth it an aptitude, the better to cut the medium) and from the multitude of little atomes descending that strike upon it, and presse it the way they go; which is downwards: then it would not import whether the inner part of that body were as solid as the outward parts; for it cutteth with onely the outward, and is smitten onely upon the outward. And yet experience sheweth us the contrary: for a great bullet of lead, that is solid and lead throughout; descendeth faster then if three quarters of the diameter were hollow within; and such a one falling upon any resisting substance, worketh a greater effect then a hollow one. And a ball of brasse that hath but a thin outside of metall will swim upon the water, when a massie one sinketh presently. Whereby it appeareth, that it is rather some other quality belonging to the very bulk of the metall in it self; and not these outward causes that occasion gravity.

But this difficultie is easily overcome, if you consider how subtile those atomes are which descending downwards and striking

ing upon a body in their way, do cause its motion likewise downwards: for you may remember how we have shewed them to be the subtilest and the minutest divisions that *light*, the subtilest and sharpest divider in nature, can make. It is then easie to conceive that these extreme subtile bodies do penetrate all others, as light doth glasse; and do run through them, as sand doth through a small sieve, or as water through a spunge; so that they strike, not onely upon the superficies, but as well in every most interiour part of the whole body; running quite through it all, by the pores of it. And then, it must needs follow that the solider it is; and the more parts it hath within (as well as without) to be strucken upon; the faster it must go, and the greater effect it must work in what it falleth upon: whereas if three quarters of the diameter of it within, should be filled with nothing but with aire; the atomes would fly without any considerable effect through all that space, by reason of the rarity and cessibility of it.

And that these atomes are thus subtile; is manifest by severall effects which we see in nature. Divers Authours that write of Egypt do assure us, that though their houses be built of strong stone; nevertheless, a clod of earth laid in the inmost rooms, and shut up from all appearing communication with aire, will encrease its weight so notably, as thereby they can judge the change of weather, which will shortly ensue. Which can proceed from no other cause, but from a multitude of little atomes of saltpeter; which floating in the aire, do penetrate through the strongest walls, and all the massie defences in their way, and do settle in the clod of earth as soon as they meet with it; because it is of a temper fit to entertain, and to conserve, and to embody them. Delights have shewed us the way, how to make the spirits or atomes of snow & saltpeter passe through a glasse vessell; which Alchimists hold to be the most impenetrable of all they can find to work with. In our own bodies; the aches which feeble parts do feel before change of weather, and the heavinesse of our heads and shoulders, if we remain in the open aire presently after sunset; do abundantly testifie, that even the grosser of these atomes (which are the first that fall) do vehemently penetrate our bodies: so as, sense will make us believe, what reason peradventure could not.

But besides all this, there is yet a more convincing reason, why the

the deſcending atomes ſhould move the whole denſity of a body; even though it were ſo denſe that they could not penetrate it, and get into the bowels of it; but muſt be content to ſtrike barely upon the outſide of it. For nature hath ſo ordered the matter, that when denſe parts ſtick cloſe together, and make the length compoſed of them to be very ſtiff; one cannot be moved but that all the reſt (which are in that line) muſt likewiſe be thereby moved: ſo that if all the world were compoſed of atoms cloſe ſticking together, the leaſt motion imaginable muſt drive on all that were in a ſtraight line, to the very end of the world. This you ſee is evident in reaſon, and experience confirmeth it, when by a little knock given at the end of a long beam, the ſhaking (which maketh ſound) reacheth ſenſibly to the other end. The blind man that governeth his ſteps by feeling in defect of eyes, receiveth advertiſements of remote things through a ſtaff which he holdeth in his hands, peradventure more particularly then his eyes could have directed him. And the like is of a deaf man that heareth the ſound of an inſtrument, by holding one end of a ſtick in his mouth, whiles the other end reſteth upon the inſtrument. And ſome are of opinion (and they not of the rank of vulgar Philoſophers) that if a ſtaff were as long as to reach from the ſunne to us, it would have the ſame effect in a moment of time. Although for my part I am hard to believe that we could receive an advertiſement ſo farre, unleſſe the ſtaff were of ſuch a thickneſſe as being proportionable to the length might keep it from facile bending: for if it ſhould be very plyant it would do us no ſervice: as we experience in a thrid, which reaching from our hand to the ground, if it knock againſt any thing, maketh no ſenſible impreſſion in our hand.

So that in fine, reaſon ſenſe and authority do all of them ſhew us, that the leſſe the atomes ſhould penetrate into a moving body, by reaſon of the extreme denſity of it, the more efficaciouſly they would work, and the greater celerity they would cauſe in its motion. And hence we may give the fulleſt ſolution to the objection above, which was to this effect: that ſeeing diviſion is made onely by the ſuperficies or exteriour part of the denſe body; and that the virtue whereby a denſe body doth work, is onely its reſiſtance to diviſion; which maketh it apt to divide: it would follow that a hollow bowl of braſſe or iron ſhould be as

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heavie as a solide one. For we may answer, that seeing the atomes must strike through the body; and that a cessible body doth not receive their strokes so firmly as a stiffe one; nor can convey them so farre: if unto a stiffe superficies there succeed a yielding inside, the strokes must of necessity lose much of their force; and consequently, cannot move a body full of aire with so much celerity, or with so much efficacy as they may a solid one.

But then you may peradventure say, that if these strokes of the descending atomes upon a dense body, were the cause of its motion downwards, we must allow the atomes to move faster then the dense body; that so they may still overtake it and drive it along, and enter into it: whereas if they should move slower then it, none of them could come in their turn to give it a stroke, but it would be past them, and out of their reach before they could strike it. But it is evident (say you) out of these pretended causes of this motion, that such atomes cannot move so swiftly downwards, as a great dense bodie; since their littlenesse and their rarity, are both of them hindering to their motion: and therefore this cannot be the cause of that effect which we call gravity.

2. The second objection answered, and the reasons shown why atomes do continually overtake the descending dense body.

To this I reply; That to have the atomes give these blows to a descending dense body, doth not require that their naturall and ordinary motion should be swifter then the descent of such a dense body: but the very descent of it occasioneth their striking it; for as it falleth and maketh it self a way through them, they divide themselves before it, and swell on the sides and a little above it, and presently close again behind it and over it assoon as it is past. Now that closing to hinder vacuity of space is a sudden one, and thereby attaineth great velocity; which would carry the atomes in that degree of velocity further then the descending body, if they did not encounter with it in their way to retard them: which encounter and retarding implyeth such strokes upon the dense body as we suppose to cause this motion. And the like we see in water, into which letting a stone fall, presently the water that was divided by the stone, and swelleth on the sides higher then it was before, closeth upon the back of the descending stone, and followeth it so violently, that for a while after it leaveth a purling hole in the place where the stone went down, till by the repose of the stone, the water returneth likewise to its quiet; and so its superficies becometh even. In

3. A curious question left undecided.

In the third place, an enquiry occurreth emergent out of this doctrine, of the cause of bodies moving upwards and downwards. Which is, Whether there would be any naturall motion deep in the earth, beyond the activity of the sunnes beams? for out of these principles it followeth that there would not: and consequently there must be a vast orb in which there would be no motion of gravity or of levity: for suppose that the sunne beams might pierce a thousand miles deep into the body of the earth; yet there would still remain a masse, whose diameter would be near 5000 miles, in which there would be no gravitation nor the contrary motion.

For my part I shall make no difficulty to grant the inference, as farre as concerneth motion caused by our sunne: for what inconvenience would follow out of it? But I will not offer at determining whether there may not be enclosed within that great sphere of earth, some other fire, (such as the Chymists talk of) an Archeus, a Demogorgon seated in the center, like the heart in animals, which may raise up vapours and boyl an aire out of them, and divide grosse bodies into atomes; and accordingly give them motions answerable to ours, but in different lines from ours, according as that fire or sunne is situated; since the farre-searching Authour of the Dialogues de Mundo, hath left that speculation undecided, after he had touched upon it in the twelfth knot of his first Dialogue.

4. The fourth objection answered; Why the descent of the same heavy bodies is equall in so great inequality of the atomes which cause it.

Fourthly, it may be objected, that if such descending atomes as we have described were the cause of a bodies gravity, and descending towards the center; the same body would at divers times descend more and lesse swiftly; for example, after midnight when the atomes begin to descend more slowly; then likewise the same body would descend more slowly in a like proportion, and not weigh so much as it did in the heat of the day. The same may be said of summer and winter: for in winter time the atomes seem to be more grosse; and consequently to strike more strongly upon the bodies they meet with in their way as they descend: yet on the other side, they seem in the summer to be more numerous, as also to descend from a greater height; both which circumstances will be cause of a stronger stroke and more vigorous impulse upon the body they hit. And the like may be objected of divers

parts

parts of the world, for in the torrid zone it will alwayes happen as in summer in places of the temperate zone; and in the polar climes as in deepest winter: so that no where there would be any standard or certainty in the weight of bodies, if it depended upon so mutable a cause. And it maketh to the same effect, that a body which lieth under a thick rock, or any other very dense body, that cannot be penetrated by any great store of atomes; should not be so heavy as it would be in the open and free aire, where the atomes in their complete numbers have their full strokes.

For answer to these and such like instances; we are to note first, that it is not so much the number or the violence of the percussion of the striking atomes, as the density of the thing strucken which giveth the measure to the descending of a weighty body: and the chief thing which the stroke of the atomes giveth unto a dense body, is a determination of the way which a dense body is to cut unto it self: therefore multiplication or lessening of the atomes, will not make any sensible difference betwixt the weight of one dense body where many atomes do strike, and an other body of the same densitie where but a few do strike; so that the stroke downwards of the descending atomes, be greater then the stroke upwards of the ascending atomes; and thereby determineth it to weigh to the certerwards, and not rise floating upwards, which is all the sensible effect we can perceive.

Next we may observe, that the first particulars of the objection, do not reach home to enfeeble our doctrine in this particular, although we admit them to be in such sort as they are proposed: for they do withall imply such a perpetuall variation of causes, ever favourable to our position, that nothing can be inferred out of them to repugne against it. As thus: When there are many atomes descending in the aire, the same generall cause which maketh them be many, maketh them also be light in proportion to their multitude. And so, when they are few they are heavie; likewise when the atomes are light, the aire is rarified and thinne; and when they are heavie the aire is thick; and so upon the whole matter it is evident, that we cannot make such a precise and exact judgement

ment of the variety of circumstances, as to be able to determine when there is absolutely more cause of weight, and when lesse. And as we find not weight enough in either side of these opposite circumstances to turn the scales in our discourse, so likewise we find the same indifference in experience it self: for the weights we use do weigh equally in misty weather and in clear: and yet in rigour of discourse, we cannot doubt but that in truth they do not gravitate or weigh so much (though the difference be imperceptible to sense) when the aire is thick and foggy, as when it is pure and rarified: which thickness of the medium, when it arriveth to a very notable degree, as for example to water, maketh then a great difference of a heavie bodies gravitation in it; and accordingly we see a great difference between heavie bodies descending in water and in aire; though between two kinds of aire none is to be observed, their difference is so small in respect of the density of the body that descendeth in them. And therefore, seeing that an assured and certain difference in circumstances maketh no sensible inequality in the effect; we cannot expect any from such circumstances as we may reasonably doubt whether there be any inequality among them or no.

Besides that, if in any of the proposed cases a heavy body should gravitate more, and be heavier one time then another; yet by weighing it, we could not discern it; since that the counterpoise (which is to determine its weight) must likewise be in the same proportion heavier then it was. And besides weighing, no other means remaineth to discover its greater gravitation, but to compare it to time in its descent: and I believe that in all such distances as we can try it in, its inequalities will be no whit lesse difficult to be observed that way, then any other.

5. The reason why the shelter of a thick body doth not hinder the descent of that which is under it.

Lastly, to bend our discourse particularly to that instance of the objection; where it is conceived that if gravity or descending downwards of bodies proceeded from atomes striking upon them as they move downwards; it would follow, that a stone or other dense body lying under shelter of a thick, hard, and impenetrable adamantine rock, would have no impulse downwards, and consequently would not weigh there. We may note, that no body whatsoever compacted by physicall causes and agents, can be so dense and imporous, but that such

such atomes, as these we speak of, must be in them, and in every part of them, and every where passe through and through them; as water doth through a seive or through a spunge: and this universall maxime must extend as farre as the sunne, or as any other heat communicating with the sunne, doth reach and is found.

The reason whereof is, because these atomes are no other thing, but such extreme little bodies as are resolved by heat; out of the main stock of those massie bodies upon which the sun and heat do work. Now then it being certain, out of what we have heretofore said, that all mixt bodies have their temper and consistence, and generation from the mingling of fire with the rest of the Elements that compose them; and from the concoction or digestion which fire maketh in those bodies: it is evident, that no mixt body whatsoever, nor any sensible part of a mixt body, can be void of pores capable of such atomes, nor can be without such atomes, passing through those pores; which atomes by mediation of the aire (that likewise hath its share in such pores) must have communication with the rest of the great sea of aire, and with the motions that passe in it. And consequently, in all and every sensible part, of any such extreme dense, and pretended impenetrable body, (to the notice whereof we can arrive) this percussion of atomes must be found; and they will have no difficulty in running through; nor by means of it, in striking any other body lying under the shelter of it; and thus both in & from that hard body, there must be still an uninterrupted continuation of gravity or of descending towards the center.

Unto which we may adde, that the stone or dense body cannot lie so close to the rock that covereth it, but that some aire must be between, (for if nothing were between, they would be united, and become one continued body;) and in that aire (which is a creek of the great ocean of aire spred over the world, that is every where bestrewed with moving atomes; and which is continually fed, like a running stream, with new aire that driveth on the aire it overtaketh) there is no doubt but there are descending atomes, as well as in all the rest of its main body: and these descending atomes meeting with the stone, must needs give some stroke upon it; and that stroke (be it never so little) cannot chuse but work some effect, in making the stone remove a little that

way they go; and that motion, whereby the space is enlarged, between the stone and the sheltering rock, must draw in a greater quantity of aire and atomes to strike upon it. And thus by little and little, the stone passeth through all the degrees of tardity by which a descending body parteth from rest: which is by so much the more speedily done, by how much the body is more eminent in density. But this difference of time, in regard of the atomes strokes onely; and abstracting from the bodies density; will be insensible to us; seeing (as we have said) no more is required of them, but to give a determination downwards.

6. The reason why some bodies sink, others swimme.

And out of this, we clearly see the reason why the same atomes, striking upon one body lying upon the water, do make it sink; and upon another they do not. As for example, if you lay upon the superficies of some water, a piece of iron, and a piece of cork, of equall bignesse and of the same figure; the iron will be beaten down to the bottome, and the cork will float at the top. The reason whereof is, the different proportions of the comparison of their densities with the densitie of water: for (as we have said) the efficacy and force of descending, is to be measured by that. So then the strokes of the atomes, being more efficacious upon water then upon cork, because the density of water is greater then the density of cork considering the abundance of aire that is harboured in the large pores of it; it followeth, that the atomes will make the water go down more forcibly then they will cork. But the density of iron exceeding the density of water; the same strokes will make the iron descend faster then the water; and consequently, the iron must sink in the water, and the cork will swimme upon it.

And this same is the cause, why if a piece of cork be held by force at the bottome of the water; it will rise up to the top of the water, as soon as the violence is taken away that kept it down: for the atomes strokes having more force upon the water then upon the cork; they make the water sink and slide under it; first, a little thinne plate of water; and then another, a little thicker; and so by degrees more and more, till it hath lifted the cork quite up to the top.

7. The fifth objection answered concerning the

Fifthly, it may be objected, that these atomes do not descend alwayes perpendicularly, but sometimes slopingly; and in that case, if their strokes be the cause of dense bodies moving, they should

descending of heavy bodies in streams.

should move sloping, and not downward. Now that these atomes descend sometimes slopingly, is evident, as when (for example) they meet with a stream of water, or with a strong wind, or even with any other little motion of the aire, such as carryeth feathers up and down hither and thither; which must needs waft the atomes in some measure along with them their way; seeing then that such a gentle motion of the aire is able to put a feather out of its way, notwithstanding the percussions of the atomes upon it; why shall it not likewise put a piece of iron out of its way downwards, since the iron hath nothing from the atomes but a determination to its way? But much more, why should not a strong wind, or a current of water, do it; since the atomes themselves that give the iron its determination must needs be hurried along with them?

To this we answer, that we must consider, how any wind, or water which runneth in that sort, is it self originally full of such atomes; which continually, and every where, presse into it and cut through it, in pursuing their constant perpetuall course of descending; in such sort, as we shewed in their running through any hard rock, or other densest body. And these atomes do make the wind or the water primarily tend downwards; though other accidentall causes impell them secondarily to a sloping motion. And still, their primary naturall motion will be in truth strongest; though their not having scope to obey that, but their having enough to obey the violent motion, maketh this become the more observable. Which appeareth evidently out of this; that if there be a hole in the bottome of the pipe that conveyeth water slopingly, be the pipe never so long, and consequently the sloping motion never so forcible; yet the water will run out at that hole to obey its more powerfull impulse to the centerwards, rather then continue the violent motion, in which it had arrived to a great degree of celerity

Which being so, it is easie to conceive that the atomes in the wind or water which move perpendicularly downwards, will still continue the irons motion downwards, notwithstanding the mediums sloping motion: since the prevailing force determineth both the iron, and the medium downwards; and the iron hath a superproportion of density to cut its way, according as the prevalent motion determineth it.

But if the descending atomes, be in part carried along down the stream by the current of wind or water; yet still the current bringeth with it new atomes into the place of those that are carried away; and these atomes, in every point of place whersoever they are, do of themselves tend perpendicularly downwards; howbeit they are forced from the complete effect of their tendance, by the violence of the current: so that in this case they are moved by a declining motion, compounded of their own naturall motion, and of the forced motion, with which the stream carrieth them. Now then if a dense body do fall into such a current where these different motions give their severall impulses, it will be carried (in such sort as we say of the atomes; but in another proportion) not in a perpendicular but in a mixt declining line, compounded of the several impulses, wch the atomes and the current do give it (in which also it is to be remembred, how the current giveth an impulse downwards, as well as sloping; and peradventure the strongest downwards:) and the declination will be more or lesse; according as the violent impulse prevaileth more or lesse against the naturall motion.

But this is not all that is to be considered in estimating the declination of a dense bodies motion when it is sinking in a current of wind or water; you must remember that the dense body it self hath a particular virtue of its own (namely its density) by which it receiveth and prosecuteth more fully its determination downwards; and therefore the force of that body in cutting its way through the medium, is also to be considered in this case, as well as above, in calculating its declining from the perpendicular; & out of all these causes wil result a middle declination compounded of the motion of the water or wind both wayes, and of its own motion by the perpendicular line. And since of these three causes of a dense bodies motion, its own virtue in prosecuting by its density the determination it requireth, is the most efficacious by much after it hath once received a determination from without; its declination will be but little if it be very dense and heavie. But if it recede much from densitie, so as to have some near proportion to the densitie of the medium, the declination will be great. And in a word, according as the body is heavier or lighter, the declination will be more or lesse, in the same current through not exactly

exactly according to the proportion of the diminishing of its density, as long as there is a superproportion of its density to the medium: since that such a superproportion (as we have declared heretofore) maketh the mediums operation upon the dense body scarce considerable.

And hence you see why a stone or piece of iron, is not carried out of its way as well as a feather; because the stones motion downwards is greater and stronger then the motion of a feather downwards. And by consequence, the force that can deturn a feather from its course downwards, is not able to deturn a stone. And if it be replied, that it may be so ordered that the stone shall have no motion, before it be in the stream of a river, and notwithstanding it will still move downwards: we may answer, that considering the little declivity of the bed of such a stream, the strongest motion of the parts of the stream, must necessarily be downwards; and consequently, they will beat the stone downwards. And if they do not the like to a feather or other light body; it is because other parts of the stream, do get under the light body; and beat it upwards, which they have not power enough to do to the stone.

8. The sixth objection answered: and that all heavy elements do weigh in their own spheres.

Sixthly, it may be objected, that if Elements do not weigh in their own spheres; then their gravity and descending must proceed from some other cause and not from this percussion of the atomes we attribute to it; which percussion we have determined goeth through all bodies whatsoever, and beateth upon every sensible part of them. But that Elements weigh not in their own spheres, appeareth out of the experience of a syphon; for though one leg of a syphon, be sunk never so much deeper into the body of the water, then the other leg reacheth below the superficies of the water: nevertheless, if once the outward leg become full of water, it will draw it out of the other longer leg: which it should not do, if the parts of water that are compriſed within their whole bulke, did weigh; seeing that the bulke of water is much greater in the sunk legge then in the other; and therefore these should rather draw back the other water into the ciſtern, then be themselves drawn out of it into the aire.

To this we answer, that it is evident the Elements do weigh in their own spheres; at least, as far as we can reach to their spheres:

for we see that a ballone stuffed hard with aire is heavier then an empty one. Again more water would not be heavier then lesse if the inward parts of it did not weigh: and if a hole were digged in the bottome of the sea, the water would not run into it and fill it, if it did not gravitate over it. Lastly, there are those who undertake to distinguish in a deep water, the divers weights which severall parts of it have, as they grow still heavier and heavier towards the bottome: and they are so cunning in this art, that they professe to make instruments which by their equality of their weight to a determinate part of the water, shall stand just in that part, and neither rise nor fall higher or lower: but if it be put lower, it shall ascend to its exact equally weighing orbe of the water; and if it be put higher, it shall descend untill it cometh to rest precisely in that place. Whence it is evident, that parts of water do weigh within the bulk of their main body; and of the like we have no reason to doubt, in the other two weighty Elements.

As for the opposition of the syphon, we referre that point to where we shall have occasion to declare the nature of that engine, of set purpose. And there we shall shew, that it could not succeed in its operation, unlesse the parts of water did gravitate in their main bulk, into which one leg of the syphon is sunk.

9. The seaventh objection answered: and the reason why we do not feel the course of the aire and atomes that beat continually upon us.

Lastly, it may be objected, that if there were such a course of atomes as we say; and that their strokes were the cause of so notable an effect, as the gravity of heavy bodies: we should feel it palpably in our own bodies, which experience sheweth us we do not.

To this we answer first, that their is no necessity we should feel this course of atomes, since by their subtilty they penetrate all bodies; and consequently, do not give such strokes as are sensible. Secondly, if we consider that dusts, and strawes, and feathers do light upon us without causing any sense in us; much more we may conceive that atomes (which are infinitely more subtile and light) cannot cause in us any feeling of them. Thirdly, we see that what is continuall with us, and mingled in all things doth not make us take any especiall notice of it: and this is the case of the smiting of atomes. Nevertheless, peradventure we feel them in truth, as often as we feel hot and cold weather, and in all catarres or other such changes, which do as it were

sink.

sink into our body without our perceiving any sensible cause of them: for no question but these atomes are the immediate causes of all good and bad qualities in the aire. Lastly, when we consider that we cannot long together hold out our arm at length, or our foot from the ground, and reflect upon such like impotencies of our resisting the gravity of our own body: we cannot doubt but that in these cases we feel the effect of these atomes, working upon those parts; although we cannot by our sense discern immediately that these are the causes of it.

10. How in the same body, gravity may be greater then density, and density then gravity; though they be the same thing.

But now it is time to draw our Reader out of a difficulty, which may peradventure have perplexed him in the greatest part of what he hath hitherto gone over. In our investigation of the Elements, we took for a principle thereunto: that gravity is sometimes more, sometimes lesse, then the density of the body in which it is. But in our explication of rarity and density; and again in our explication of gravity; we seem to put, that gravity and density is all one. This thorn I apprehend, may in all this distance, have put some to pain: but it was impossible for me to remedy it; because I had not yet delivered the manner of gravitation. Here then I will do my best, to assuage their grief, by reconciling these appearing repugnancies.

We are therefore to consider, that density (in it self) doth signifie a difficulty to have the parts of its subject, in wch it is, separated one from another; and that gravity (likewise in it self) doth signifie a quality, by which a heavy body doth descend towards the center; or (which is consequent thereunto) a force to make another body descend. Now this power, we have shewed, doth belong unto density, so far forth as a dense body being strucken by another, doth not yield by suffering its parts to be divided; but, with its whole bulk striketh the next before it, and divideth it, if it be more divisible then it self is. So that you see, density hath the name of density, in consideration of a passive quality or rather of an impassibility which it hath; and the same density is called gravity, in respect of an active quality it hath which followeth this impassibility. And both of them are estimated by the different respects which the same body or subject, in which they are, have unto different bodies that are the terms whereunto it is compared; for the active quality or gravity of a dense body, is esteemed by its respect to the body it striketh upon; whereas its

denſity includeth a reſpect ſingly to the body that ſtriketh it.

Now it is no wonder that this change of compariſon worketh a diſparity in the denominations: and that thereby the ſame body may be conceived to be more or leſſe impartible, then it is active or heavy. As for example, let us of a denſe Element take any one leaſt part, which muſt of neceſſity be in its own nature and kind abſolutely impartible: and yet it is evident that the gravity of this part muſt be exceeding little by reaſon of the littleneſſe of its quantity; ſo that thus you ſee an extremity of the effect of denſity, joyned together in one body (by the accident of the littleneſſe of it) with a contrary extremity of the effect of gravity, (or rather with the want of it) each of them within the limits of the ſame ſpecies. In like manner it happeneth, that the ſame body in one circumſtance is more weighty, in another (or rather in the contrary) is more partible: ſo water when it is in a pail, becauſe it is thereby hindered from ſpreading abroad hath the effect of gravity predominating in it; but if it be poured out, it hath the effect of partibility more. And thus it happeneth that merely by the gradation of rarity & denſity, one denſe body may be apt, out of the generall courſe of naturall cauſes, to be more diviſible then to be a divider; though according to the nature of the degrees conſidered abſolutely in themſelves, what is more powerfull to divide, is alſo more reſiſtent and harder to be divided. And this arriveth in that degree which maketh water; for the falling and beating of the atomes upon water, hath the power both to divide it and to make it deſcend; but ſo, that by making it deſcend it divideth it. And therefore we ſay that it hath more gravity then denſity, though it be the very denſity of it, which is the cauſe that maketh it partible, by the working of one part upon another: for if the atomes did not find the body ſo denſe as it is, they could not by their beating upon one part make another be divided.

So that a denſe body to be more heavy then denſe, ſignifieth nothing elſe, but that it is in ſuch a degree of denſity, that ſome of its own parts by their being aſſiſted & ſet on work by a generall cauſe (which is the fall of the atomes) are powerfull enough to divide other adjoyning parts of the ſame denſity with them one from another; in ſuch ſort as we ſee that water poured out of an ewer into a baſin where there is already other water, hath the power to divide the water in the baſin by the aſſi-

ſtance

stance of the celerity which it getteth in descending. And now I hope the reader is fully satisfied that there is no contradiction in putting *Density* and *Gravity* to be the same thing materially; and that nevertheless the same thing may be more heavie then dense, or more dense then heavy, as we took it to our severall purposes in the investigation of the Elements.

11. The opinion of gravities being an intrinsecall inclination of a body to the center, refuted by reason.

Having thus laid an intelligible ground to discover how these motions that are generall to all bodies and are naturall in chief, are contrived by nature; we will now endeavour to shew that the contrary position is not onely voluntary, but also impossible. Let us therefore suppose that a body hath a quality to move it downwards. And first we shall ask what downwards signifieth: for either it signifieth towards a fixed point of imaginary space; or towards a fixed point of the universe; or towards some moveable point. As for the first, who would maintain it must have more imagination then judgement, to think that a naturall quality could have an essence determined by a nothing: because we can frame a conceit of that nothing. As for the second, it is very uncertain whether any such point be in nature: for as for the center of the earth, it is clear that if the earth be carried about, the center of it cannot be a fixed point. Again, if the center signifieth a determinate point in the earth that is the medium of gravity or of quantity, it is changed as often as any dust lighteth unequally upon any one side of the earth, which would make that side bigger then it was: and I doubt a quality cannot have morall considerations to think that so little doth no harm. As for the third position, likewise it is not intelligible how a quality should change its inclination or essence, according to the change that should light to make now one point, now another, be the center unto which it should tend.

Again, let us consider that a quality hath a determinate essence. Then seeing its power is to move, and to move signifieth to cut the medium it is moved in; it belongeth unto it of its nature to cut so much of such a medium in such a time. So that if no other cause be added but that you take precisely and *in abstracto*, that quality, that medium, & that time; this effect will follow, that so much motion is made. And if this effect should not follow it is clear, that the being able to cut so much of such a medium in such a time, is not the essence of this quality, as it was supposed to be. Dividing then the time & the medium, half the motion should

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be made in half the time, a quarter of the motion in a quarter of the time, and so without end, as farre as you can divide. But this is demonstratively impossible, sith hence it is demonstrated that a moveable coming from rest, must of necessity passe through all degrees of tardity; and therefore by the demonstration cited out of Galileus, we may take a part in which this gravity cannot move its body in a proportionate part of time, through a proportionate part of the medium.

12. The same opinion refuted by severall experiences.

But because in naturall Theorems, experiences are naturally required; let us see whether nature giveth us any testimony of this verity. To that purpose we may consider a plummet hanged in a small string from a beam, which being lifted up gently on the one side at the extent of the string, and permitted to fall merely by the power of gravity, it will ascend very near as high on the contrary side, as the place it was held in from whence it fell. In this experiment we may note two things: the first, that if gravity be a quality, it worketh against its own nature in lifting up the plummet, seeing its nature is onely to carry it down. For though it may be answered, that it is not the gravity but another quality called *vis impressa* which carrieth it up: nevertheless it cannot be denied, but that gravity is either the immediate or at least the mediate cause which maketh this *vis impressa*: the effect whereof being contrary to the nature of gravity, it is absurd to make gravity the cause of it: that is, the cause of an essence, whose nature is contrary to its own. And the same argument will proceed though you put not *vis impressa*, but suppose some other thing to be the cause of the plummets remounting, as long as gravity is said to be a quality: for still gravity must be the cause of an effect contrary to its own inclination, by setting on foot the immediate cause to produce it.

The second thing we are to note in this experiment of the plummets ascent is, that if gravity be a quality, there must be as much resistance to its going up, as there was force to its coming down. Therefore there must be twice as much force to make it ascend, as there was to make it descend: that is to say, there must be twice as much force as the naturall force of the gravity is: for there must be once as much to equalize the resistance of the gravity; and then another time as much, to carry

it

it as farre through the same medium in the same time. But it is impossible that any cause should produce an effect greater then it self.

Again, the gravity must needs be in a determinate degree: and the virtue that maketh the plummet remount (whatsoever it be) may be put as little as we please: and consequently not able to oversway the gravity alone if it be an intrinsecall quality, and yet the plummet will remount: in which case you put an effect without a cause.

Another experience we may take from the force of sucking; for take the barrell of a long gun perfectly bored, and set it upright, with the breech upon the ground, and take a bullet that is exactly fit for it, but so as it stick not any where (both the barrell and it being perfectly polished;) and then if you suck at the mouth of the barrell (though never so gently) the bullet will come up so forcibly, that it will hazard the striking out of your teeth. Now let us consider what force were necessary to suck the bullet up, and how very slowly it would ascend, if in the barrell it had as much resistance to ascend, as in the free aire it hath inclination to go down. But if it had a quality of gravity naturall to it, it must of necessity have such resistance: whereas in our experiment we see it cometh as easily as the very aire. So that in this example as well as in the other, nature teacheth us that gravity is no quality.

And all or most of the arguments which we have urged against the quality of gravity in that explication we have considered it in, have force likewise against it, although it be said to be an inclination of its subject to move it self unto unity with the main stock of its own nature, as divers witty men do put it: for this supposition doth but change the intention or end of gravity: and is but to make it another kind of intellectuall or knowing Entity, that determineth it self to another end: which is as impossible for a naturall quality to do, as to determine it self to the former ends. And thus much the arguments we have proposed do convince evidently, if they be applyed against this opinion.

CHAP.

## CHAP. XII.

### *Of Violent Motion.*

1. The state of the question touching the cause of violent motion.

AND thus we have given a short scantling, whereby to understand in some measure the causes of that motion which we call naturall, by reason it hath its birth from the universall oeconomy of nature here among us; that is, from the generall working of the sunne, whereby all naturall things have their course: and by reason that the cause of it is at all times and in all places constantly the same. Next unto which the order of discourse leadeth us to take a survey of those forced motions, whose first causes the more apparent they are, the more obscurity they leave us in, to determine by what means they are continued

When a tennis-ball is strucken by a racket, or an arrow is shot from a bow, we plainly see the causes of their motion: namely the strings, which first yielding, and then returning with a greater celerity, do cause the missives to speed so fast towards their appointed homes. Experience informeth us what qualities the missives must be endued withall to move fast and steadily. They must be so heavy that the aire may not break their course; and yet so light, that they may be within the command of the stroke which giveth them motion; the striker must be dense, and in its best velocity: the angle which the missive is to mount by (if we will have it go to its furthest randome) must be the half of a right one: and lastly, the figure of the missive must be such, as may give scope unto the aire to bear it up, and yet not hinder its course by taking too much hold of it. All this we see; but when withall we see that the mover deserteth the moveable assoon as he hath given the blow; we are at a stand, and know not where to seek for that which afterwards maketh it flie: for motion being a transient, not a permanent thing, assoon as the cause ceaseth that begot it, in that very point it must be at an end; and as long as the motion continueth, there must be some permanent cause to make it do so: so that as soon as the racket or bowstring go back & leave the ball or arrow, why should not they presently fall straight down to the ground?

2. That the medium is the onely

Aristotle and his followers have attributed the cause hereof to the aire: but Galileo relisheth not this conception. His arguments

ments against it, are (as I remember) to this tenour: first, aire by reason of its rarity and divisibility, seemeth not apt to conserve motion: next, we see that light things are best carried by the aire; and it hath no power over weighty ones: lastly, it is evident that aire taketh most hold of the broadest superficies; and therefore an arrow would flie faster broad-wayes then long-wayes, if this were true. Nevertheless, since every effect must have a proportionable cause from whence it immediately floweth; and that a body must have another body to thrust it on as long as it moveth; let us examine what bodies do touch a moveable whilest it is in motion: as the onely means to find an issue out of this difficulty; for to have recourse unto a quality or impressed force for deliverance out of this straight, is a shift that will not serve the turn in this way of discourse we use. In this Philosophy no knot admitteth such a solution.

cause, which continueth violent motion.

If then we enquire what body it is that immediately toucheth the ball or arrow whiles it flieth; we shall find that none other doth so but the aire and the atomes in it, after the strings have given their stroke, and are parted from the missive. And although we have Galileos authority, and arguments to discourage us from believing that the aire can work this effect; yet since there is no other body besides it left for us to consider in this case, let us at the least examine how the aire behaveth it self after the stroke is given by the strings. First then it is evident that assoon as the racket or bow-string shrinketh back from the missive, and leaveth a space between the missive and it (as it is clear it doth, assoon as it hath strucken the resisting body) the aire must needs clap in with as much velocity as they retire, and with somewhat more; because the missive goeth forward at the same time, and therefore the aire must hasten to overtake it, least any vacuity should be left between the string and the arrow. It is certain likewise, that the aire on the sides doth also upon the division of it, slide back and help to fill that space which the departed arrow leaveth void. Now this forcible closing of the aire at the nock of the arrow, must needs give an impulse or blow upon it: if it seem to be but a little one, you may consider how it is yet much greater, then what the aire and the bodies swimming in it, do at the first give unto a stone falling from high: and how at the last those little atomes that drive a

stone

stone in its naturall motion, do with their little blows force it peradventure more violently & swiftly then any impelling agent we are acquainted with can do. So that the impulse which they make upon the arrow, pressing violently upon it after such a vehement concussion, and with a great velocity, must needs cause a powerfull effect in that which of it self is indifferent to any motion any way.

3. A further explication of the former doctrine

But unlesse this motion of the aire do continue to beat still upon the arrow, it will soon fall to the ground, for want of a cause to drive it forward; and because the naturall motion of the aire (being then the onely one) will determine it downwards. Let us consider then how this violent rending of the aire by the blow that the bow-string giveth unto the arrow, must needs disorder the little atomes that swim to and fro in it, and that (being heavier then the aire) are continually descending downwards This disorder maketh some of the heavier parts of them, get above others that are lighter then they; which they not abiding, do presse upon those that are next them, and they upon their fellows: so that there is a great commotion and undulation caused in the whole masse of aire round about the arrow: which must continue some time before it can be settled: and it being determined by the motion of the arrow that way that it slideth, it followeth that all this commotion and undulation of the aire, serveth to continue the arrow in its flight. And thus faster then any part behind can be settled, new ones before are stirred, till the resistance of the medium do grow stronger then the impulse of the movers.

Besides this, the arrow pressing upon the aire before it, with a greater velocity then the aire (which is a liquid rare body) can admit, to move all of a piece without breaking: it must of necessity happen that the parts of the aire immediately before the arrow be driven upon others further off, before these can be moved to give place unto them; so that in some places the aire becometh condensed, and consequently in others rarified. Which also the wind that we make in walking (which will shake a paper pinned loosely at the wall of a chamber towards which we walk) and the cooling aire caused by fanning when we are hot do evidently confirm. So that it cannot be doubted, but that condensation and rarefaction of the aire must necessarily follow the

the motion of any solid body: which being admitted it is evident that a great disorder, and for some remarkable time, must necessarily be in the aire; since it cannot brook to continue in more rarity or density then is naturall unto it. Nor can weighty and light parts agree to rest in an equall height or lowness; which the violence of the arrows motion forceth them unto for the present. Therefore it cannot be denied, but that though the arrow slide away, nevertheless there still remaineth behind it (by this condensation and confusion of parts in the aire) motion enough to give impulse unto the arrow, so as to make it continue its motion after the bowstring hath left it.

4. That the aire hath strength enough to continue violent motion in a moveable. Dial. 1. of motion pag. 98.

But here will arise a difficulty: which is, how this clapping in and undulation of the aire should have strength and efficacy enough to cause the continuance of so smart a motion, as is an arrows shot from a bow. To this I need no other argument for an answer then to produce Galileos testimony, how great a body one single mans breath alone can in due circumstances give a rapid motion unto: and withall, let us consider how the arrow and the aire about it are already in a certain degree of velocity; that is to say, the obstacle that would hinder it from moving that way (namely, the resistance of the aire) is taken away; and the causes that are to produce it (namely the determining of the aires, and of the atomes motion that way) are hightened. And then we may safely conclude that the arrow which of it self is indifferent to be moved upwards or downwards, or forwards, must needs obey that motion which is caused in it by the atomes, and the aires pressing upon it; either according to the impulse of the string; or (when the string beginneth to flag) according to the beatings that follow the generall constitution of nature; or in a mixt manner according to the proportions that these two hold to one another. Which proportions Galileus in his 4. Dialogue of motion hath attempted to explicate very ingeniously: but having missed in one of his suppositions; to wit, that forced motion upon an horizontall line, is throughout uniform; his great labours therein have taken little effect towards the advancing the knowledge of nature, as he pretended: for his conclusions succeed not in experience, as Mersenius assureth us after very exact trialls; nor can they in their reasons be fitted to nature.

So that to conclude this point; I find no difficulty in allowing this

this motion of the aire strength enough to force the moveable onwards, for some time after the first mover is severed from it; (and long after, we see no motions of this nature do endure:) so that we need seek no further cause for the continuance of it: but may rest satisfied upon the whole matter, that since the causes and circumstances our reason suggesteth unto us, are after mature and particular examination proportionable to the effects we see, the doctrine we deliver must be sound and true.

5. An answer to the first objection; that aire is not apt to conserve motion. And how violent motion cometh to cease.

For the establishing whereof, we need not (considering what we have already said) spend much time in solving Galileos arguments against it: seeing that, out of what we have set down, the answers to them appear plain enough; for first, we have assigned causes how the aire may continue its motion long enough to give as much impression as is needfull unto the arrow, to make it go on as it doth. Which motion is not requisite to be near so great in the aire behind the arrow (that driveth it on) as what the arrow causeth in the aire before it: for by reason of the density of it, it must needs make a greater impression in the aire it cutteth, then the aire that causeth its motion, would do of it self without the mediation of the arrow. As, when the force of a hand giveth motion unto a knife to cut a loafe of bread, the knife, by reason of the density and of the figure it hath, maketh a greater impression in the loaf, then the hand alone would do. And this is the same that we declared in the natural motion of a heavie thing downwards, unto which we assigned two causes; namely, the beating of the atomes in the aire, falling down in their naturall course, to determine it the way it is to go; and the density of the body, that cutting more powerfully then those atomes can do; giveth (together with their help) a greater velocity unto the moveable, then the atomes of themselves can give.

Nor doth it import that our resolution is against the generall nature of rare and dense bodies, in regard of conserving motion; as Galileo objecteth: for the reason why dense bodies do conserve motion longer then rare bodies, is, because in regard of their dividing virtue, they get in equall times a greater velocity. Wherefore seeing that velocity is equall unto gravity; it followeth, that resistance worketh not so much upon them as upon rare bodies; and therefore cannot make them cease from motion

tion so easily as it doth rare bodies. This is the generall reason for the conservation of motion in dense bodies. But because in our case, there is a continuall cause which conserveth motion in the aire, the aire may continue its motion longer then of it self it would do: not in the same part of aire which Galileus (as it seemeth) did aim at: but in divers parts, in which the moveable successively is.

Which being concluded, let us see how the forced motion cometh to decrease and to be ended. To which purpose we may observe that the impression which the arrow receiveth from the aire that driveth it forwards, being weaker then that which it received at the first from the string, (by reason, that the aire is not so dense, and therefore cannot strike so great a blow) the arrow doth not in this second measure of time, (wherein we consider the impulse given by the aire onely) cut so strongly the aire before it, nor presse so violently upon it, as in the first measure when the string parting from it did beat it forwards: for till then the velocity encreaseth in the arrow, as it doth in the string that carrieth it along, which proceedeth from rest at the fingers loose from it, to its highest degree of velocity; which is, when it arriveth to the utmost extent of its jerk, where it quitteth the arrow. And therefore, the aire now doth not so swiftly, nor so much of it, rebound back from before, and clap it self behind the arrow, to fill the space that else would be left void by the arrowes moving forward, and consequently the blow it giveth in the third measure, to drive the arrow on, cannot be so great as the blow was immediately after the strings parting from it; which was in the second measure of time: and therefore the arrow must needs move slower in the third measure then it did in the second; as formerly it moved slower in the second (which was the aires first stroke) then it did in the first, when the string drove it forwards. And thus successively in every moment of time, as the causes grow weaker & weaker by the encrease of resistance in the aire before, and by the decrease of force in the subsequent aire; so the motion must be slower & slower, till it come to pure cessation.

6. An answer to the second objection that the aire hath no power over heavie bodies.

As for Galileus second argument; that the aire hath little power over heavy things; and therefore he will not allow it to be the cause of continuing forced motions in dense bodies: I wish he could as well have made experience what velocity of motion

a mans breath might produce in an heavie bullet lying upon an even, hard, & slipery plain, (for a table would be too short) as he did, how admirable great a one it produced in pendants hanging in the aire: and, I doubt not but he would have granted it as powerfull in causing horizontall motions, as he found it in the undulations of his pendants. Which nevertheless, do sufficiently convince how great a power aire hath over heavie bodies. As likewise the experience of wind-guns assureth us that aire duly applied is able to give greater motion unto heavy bodies then unto light ones. For how can a straw or feather be imagined possibly to fly with half the violence as a bullet of lead doth out of one of those engines? And when a man sucketh a bullet upwards in a perfectly bored barrell of a gun, which the bullet fitteth exactly (as we have mentioned before) with what a violence doth it follow the breath and ascend to the mouth of the barrell? I remember to have seen a man that was uncautious and sucked strongly that had his foreteeth beaten out by the blow of the bullet ascending.

This experiment (if well looked into) may peradventure make good a great part of this doctrine we now deliver. For, the aire pressing in behind the bullet at the touch-hole, giveth it its impulse upwards; unto which the density of the bullet being added, you have the cause of its swiftnes and violence; (for a bullet of wood or cork, would not ascend so fast and so strongly) and the sucking away of the aire before it, taketh away that resistance which otherwise it would encounter with by the aire lying in the way of it: & its following the breath with so great ease, sheweth (as we touched before) that of it self it is indifferent to any motion, when nothing presseth upon it to determine it a certain way.

7. An answer to the third objection, that an arrow should fly faster brodewayes, then longwayes.

Now to Galileos last argument; that an arrow should fly faster broadwayes, then longwayes, if the aire were cause of its motion: there needeth no more to be said, but that the resistance of the aire before, hindreth it as much as the impulse of the aire behind helpeth it on; so that nothing is gained in that regard; but much is lost, in respect of the figure; which maketh the arrow unapt to cut the aire so well when it flyeth broadwayes, as when it is shot longwayes: and therefore the aire being weakly cut, so much of it cannot clap in behind the arrow and drive it on, against the resistance before, which is much greater.

Thus far with due respect, and with acknowledging remembrance

brance of the many admirable mysteries of nature which that great man hath taught the world, we have taken liberty to dispute against him: because this difficulty seemeth to have driven him against his Genius, to believe that in such motions there must be allowed a quality imprinted into the moved body to cause them: wch our whole scope both in this, and in all other occasions where like qualities are urged, is to prove them superfluous and ill grounded in nature; and to be but mere terms to confound & leave in the dark whosoever is forced to fly unto them.

## CHAP. XIII.

### *Of three sorts of violent motion, Reflection, Vndulation, and Refraction.*

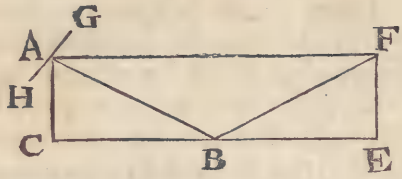
THe motion we have last spoken of, because it is ordinarily either in part or wholy contrary to gravity (which is accounted the naturall motion of most bodies) useth to be called violent or forced. And thus you have delivered unto you the natures and causes both of naturall and of forced motion; yet it remaineth that we advertise you of some particular kinds of this forced motion, which seem to be different from it, but indeed are not. As first, the motion of reflection: which if we do but consider how forced motion is made: we shall find that it is nothing else but a forced motion, whose line whereupon it is made, is as it were snapped in two by the encounter of a hard body. For even as we see in a spout of water that is strongly shot against a wall, the water following driveth the precedent parts first to the wal, and afterwards coming themselves to the wall, forceth them again another way from the wall: right so, the latter parts of the torrent of aire, which is caused by the force that occasioned the forced motion, driveth the former parts, first upon the resistant body, and afterwards again from it. But this is more eminent in light then in any other body, because light doth lesse rissent gravity; and so observeth the pure course of the stroke, better then any other body; from which others do for the most part decline some way by reason of their weight.

1. That reflexion is a kind of violent motion.

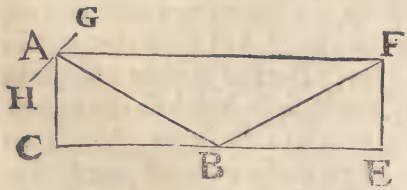
Now the particular law of reflexion is, that the line incident, & the line of reflexion must make equall angles with that line of the resistent superficies wch is in the same superficies with themselves. The demonstration whereof, that great wit Renatus Des Cartes

2. Reflexion is made at equall angles.

hath excellently set down in his book of Dioptrikes by the example of a ball strucken by a racket against the earth, or any resisting body: the substance whereof is as followeth.




In the Rectangle Parallelogramme A E, let C E be the superficies of the earth: A, the point from which the racket H G, striketh the ball by the line A B, to the point B in the superficies of the earth: and let us consider C, to be on the left hand, and E on the right. Now we are to shew that the ball will rebound by the line B F, to the point F, in the same time in which it went from A to B; and so make the angle A B C equall to the angle F B E. For the effecting whereof, we must abstract, according to the manner of mathematicians, from all Physicall inequalities, and suppose the superficies C E, to be mathematically plain, and the force of the racket to continue equally strong in B as it is in A: for although in truth, neither of these be rigorously so; nevertheless, because there is no sensible defect in any operation that dependeth on them, it is the same to our purpose as if they were mathematically so. We see then that the racket H G, doth in a certain time drive the ball from A to B; that is to say, from the left hand to the right, as farre as from C to B; and from above to downwards as farre as from A to C. We see again, that the superficies C E, is not contrary unto this motion of the ball, as it goeth from the left hand to the right; for the line C E lyeth likewise that way: but is contrary unto it, as it goeth from above downwards; for in that course the superficies C E encountereth and putteth a period to the line A C. And therefore the motion of the ball when it meeteth with the superficies C E, must be changed from the line A C, so much as the superficies C E is contrary unto it; that is quite backwards as farre as it dependeth of that opposition. Therefore, when the ball is come to B, it must go from thence in the same proportion of left hand to right hand, and from below upwards, as it came before from left hand to right



hand, and from above downwards, when it came from A to B. And consequently, it must in equall time have passed another line from left hand to right hand, as long as the line C B; and likewise, it must at the same time have passed another line from below upwards as long as A C: which will of necessity make it hit in the point F, at the end of so much more time as it spent in going from A to B; and so, make the two angles A B C and F B E equall; as every one knoweth that hath but saluted Euclide.

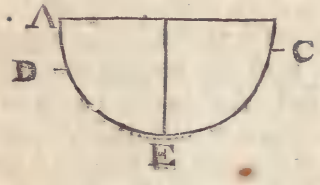
3. The causes and properties of undulation.

The motion which we call undulation needeth no further explication: for it is manifest, that since a pendant, when it is removed from its perpendicular, will restore it self thereunto by the naturall force of gravity, and that in so doing it gaineth a velocity, (and therefore cannot cease on a suddain,) it must needs be carried, out of the force of that motion, directly the contrary way: untill the force of gravity, overcoming the velocity it must be brought back again to the perpendicular: which being done likewise with velocity, it must send it again towards the place from which it fell at the first. And in this course of motion it must continue for a while, every undulation being weaker then other untill at last it quite ceaseth, by the course of nature settling the aire in its due situation according to the naturall causes that work upon it. And in this very manner also is performed that undulation which we see in water, when it is stirred from the naturall situation of its sphericall superficies.

Galileo hath noted that the time in which the undulations are made which follow one another of their own accord, is the same in every one of them; and that as much time precisely is taken up in a pendants going a very short arch towards the end of its vibration, as was in its going of the greatest arch at the beginning of its motion. The reason whereof seemeth strange to him, and he thinketh it to be an accident naturall to the body out of its gravity; and that this effect convinceth, it is not the aire which moveth such bodies. Whereas in truth, it is clearly the aire which causeth this effect. Because the aire striving at each end (where it is furthest from the force of the motion) to quiet it self, getteth at every bout somewhat upon the space; and so contracteth that into a shorter arch.

But it is a great wonder to me, that Galileo should make a

wonder of this effect to the reason which he hath laid so fair a foundation upon another occasion, had he but reflected upon it. For in his fourth dialogue of motion he hath demonstrated that a naturall moveable descending in the quarter of a circle, from what part soever it beginneth, spendeth equall time to come to the lowest point, as if it came from any other part: so that a pendant being brought up to any height by the force of a former motion downwards, it will be sure to spend as much time in going down from thence to the perpendicular, as it did at the first when it was let fall from the greatest height. Now I subsume, that the pendants ascending, being the effect of the velocity of its motion gained in descending immediately before; the said velocity must be able to carry it in the same time to a height, that is proportionate to that height unto which the velocity gained in the first fall did cause the pendant to mount. As for example: if the pendants first descent were from A to E, the second from C to E; because the time of those two is the same, (as Galileus hath demonstrated) it followeth that their velocities gained in descending must of necessity be in the proportion of the line A E to the line C E: therefore, their effects also must be proportionable. Let us then put the line E D in that proportion to the line C E, which C E hath to A E, and then the velocity gained in C E will carry the pendant up from E to D, in the same time in which the descent A E did carry it up the other way from E to C: wherefore, seeing that the times of its descent from A to E, and from C to E are equall; likewise, the two vibrations from A to C and from C to D will be done in equall times. But that which made Galileo not see the force of the consequence, was that he did not acknowledge violent motion to be made in the same proportions, and for the same reasons which are found in naturall motion: which we have above shewed to be so, where we discoursed of that matter.

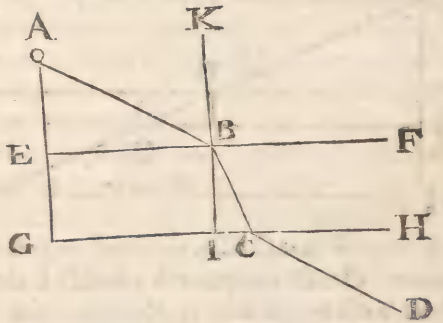



4. Refraction at the entrance into the reflectent body is

That motion also which we call *Refraction*, and is manifest to sense, onely in light; (though peradventure hereafter more diligent searchers of nature, may likewise find it in such other bodies as are called qualities; as in cold or heat, &c.) is but a kind

kind of Reflexion: for there being certain bodies, in which the passages are so well ordered with their resistances, that all the parts of them seem to permit light to passe through them, and yet all parts of them seem to reflect it; when light passeth through such bodies, it findeth at the very entrance of them, such resistances where it passeth, as serve it for a reflectent body; and yet such a reflectent body, as hindereth not the passage through; but onely hindereth the passage from being in a straight line with the line incident. Wherefore the light must needs take a ply as beaten from those parts towards a line drawn from the illuminant, falling perpendicularly upon the resisting superficies; and therefore is termed by mathematicians, to be refracted or broken towards the perpendicular. Now at the very going out again of the light, the second superficies (if it be parallel to the former) must needs upon a contrary cause, strike it the contrary way: which is termed from the perpendicular.

towards the perpendicular; at the going out it is from it; when the second superficies is parallel to the first.



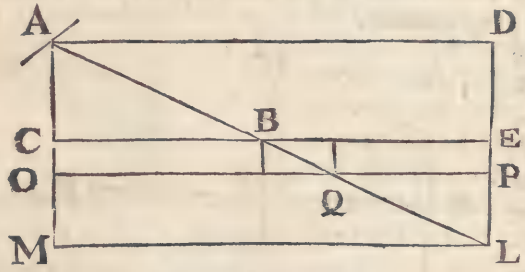

As for example: if the ray A B, lighteth upon the superficies E B F, and findeth entrance; it is not now the superficies E F, that resisteth or reflecteth it: but it is that part of the inside (as we may say) of the pore B, which is towards F; and is a Physicall body, not a Mathematicall point. The reflexion therefore must be made, as if the reflectent body were I B K: but it is evident that if A B, did strike upon I K, it would reflect towards A G. But because we know not the inclination of the superficies I K, whether it be truly a perpendicular or no, therefore we cannot tell the quantity of the inclination which this reflexion must make; but onely we know that it must be towards A G.

5. A refutation of Monsieur Des Cartes his explication of refraction.

But before we wade any deeper into this difficulty, we cannot omit a word of the manner of explicating refraction which Monsieur Des Cartes useth, so witty a one as I am sorry it wanteth successe. He therefore following the demonstration above given

given of reflection; supposeth the superficies which a ball lighteth upon, to be a thin linen cloth, or some other such matter as will break cleanly by the force of the ball striking smartly upon it. And because that superficies resisteth onely one way, therefore he inferreth that the velocity of the ball is lessened onely one way & not the other: so that the velocity of its motion that way in which it findeth no resistance, must be (after the balls passage through the linen) in a greater proportion to the velocity wch it hath the other way where it findeth resistance, then it was before. And therefore the ball will in lesse time arrive to its period on the one side then on the other: and consequently, it will lean towards that side, unto which the course wherein it findeth no opposition doth carry it.

But how much he is mistaken upon the whole matter a little figure will shew: let us therefore put a Rectangle Parallelogram as before A E, which I double & make the whole Parallelogram A L, & draw out the line A B, till it cometh to L. Now we must imagine that C E, is the cloth or passable superficies which Monsieur Des Cartes putteth; and B L the line it would go in, if there were no resistance. Next we must seek the perpendicular, which according to our explication, is A C: for that falleth from A the illuminant, perpendicularly upon C E; although, some who defend Monsieur Des Cartes, seem to make another line the perpendicular; against the conception of all those that write of Opticks. But, not to trouble our selves with terms; the question is, whether the ball that passeth the cloth, must (after its passage through) deflect from the line B L, (which it would have kept, had there been no resistance) towards E; or else deflect from that line towards C. And both experience and reason do assure us, that it must turn towards C: but Monsieur Des Cartes saith towards E.




Which to shew how it is contrary unto his own principle; let us

us conceive the cloth C E to be of some thickness, and so draw the line O P to determine that thickness. And let us make from B upon A L, another Parallelogram like the Parallelogram A L, whose diameter shall be B Q. And it must necessarily follow that the motion from B to Q, if there were no resistance, were in the same proportion as from A to B. But the proportion of the motion from A to B, is the proportion of CB to CA; that is, it goeth in the same time faster towards D, then it doth towards M, in the proportion which CB hath to CA. By which account, the resistance it hath in the way towards D, must also be greater then the resistance it hath in the way towards M, in the proportion which CB hath to CA; and therefore the more tardity must be in the way to D, and not in the way to M; and consequently, the declination must be from E wards, and to M wards. For where there is most resistance, that way likewise must the tardity be greatest, & the declination must be from that way: but which way the thickness, to be passed in the same time, is most, that way the resistance is greatest: and the thickness is clearly greater towards E, then towards M; therefore, the resistance must be greatest towards E; & consequently the declination from the line BL must be towards M, and not towards E.

But the truth is, that in his doctrine the ball would go in a straight line as if there were no resistance; unless perad venture towards the contrary side of the cloth, at which it goeth out into the free aire: for as the resistance of the cloth is greater in the way towards D, then in the way towards M, (because it passeth a longer line in the same time, as also it did formerly in the aire) so likewise is the force that moveth it that way greater then the force which moveth it the other. And therefore the same proportions that were in the motion, before it came to the resisting passage, will remain also in it: at the least untill coming near the side at which it goeth out, the resistance be weakned by the thinness of the resistent there: which because it must needs happen on the side that hath least thickness, the ball must consequently turn the other way, where it findeth greatest yielding: and so at its getting out into the free aire, it will bend from the greater resistance, in such manner as we have said above.

Neither do the examples brought by Monsieur Des Cartes and others in maintenance of this doctrine any thing avail them:

An answer to the arguments brought in favour of Monsieur Des Chartes his opinion.

them: for when a canon bullet shot into a river, hurteth the people on the other side; it is not caused by refraction, but by reflection, as Monsieur Des Cartes himself acknowledgeth: and therefore, hath no force to prove any thing in refraction; whose laws are divers from those of pure reflexion.

And the same answer serveth against the instance of a musket bullet shot at a mark under water; which perpetually lighteth higher then the mark, though it be exactly just aimed at. For we knowing that it is the nature of water, by sinking in one place to rise round about, it must of necessity follow that the bullet which in entring hath pressed down the first parts of the water, hath withall thereby put others further off in a motion of rising: and therefore the bullet in its going on must meet with some water swelling upwards, & must from it receive a ply that way, which cannot fail of carrying it above the mark it was levelled at. And so we see this effect proceedeth from reflection or the bounding of the water, and not from refraction. Besides that, it may justly be suspected the shooter took his aim too high, by reason of the marks appearing in the water higher then in truth it is: unlesse such false aiming were duly prevented.

Neither is Monsieur Des Cartes his excuse to be admitted, when he saith that light goeth otherwise then a ball would do, because that in a glasse or in water, the etheriall substance which he supposeth to run through all bodies, is more efficaciously moved then in aire: and that therefore light must go faster in the glasse then in the aire, and so turn on that side of the straight line which is contrary to the side that the ball taketh, because the ball goeth not so swiftly. For (not to dispute of the verity of this proposition) the effect he pretendeth is impossible: for if the etheriall substance in the aire before the glasse be slowly moved, (the motion of which he calleth light) it is impossible that the etheriall substance in the glasse or in the water should be more smartly moved then it. Well it may be lesse; but without all doubt the impulse of the etheriall substance in the glasse cannot be greater then its adequate cause, which is the motion of the other parts that are in the aire precedent to glasse.

Again, after it is passed the glasse, it should return to be a straight line with the line that it made in the aire precedent to the glasse: seeing that the subsequent aire must take off just as much (and no more) as the glasse did adde: the contrary whereof experience sheweth us.

Thirdly,

Thirdly, in this explication it would alwayes go one way in the aire, and another way in the glasse: whereas all experience testifieth, that in a glasse convex on both sides, it still goeth in the aire after its going out to the same side as it did in the glasse; but more. And the like happeneth in glasses on both sides concave. Wherefore it is evident, that it is the superficies of the glasse that is the worker on both sides; and not the substance of the aire on the one side, and of the glasse on the other.

And lastly, his answer doth no way solve our objection, which proveth that the resistance both wayes is proportionate to the force that moveth, and by consequence that the thing moved must go straight. As we may imagine would happen if a bullet were shot sloping through a green mud wall, in which there were many round sticks so thin set that the bullet might passe with ease through them; for as long as the bullet touched none of them (which expresseth his case) it would go straight; but if it touched any of them ( which resembleth ours, as by and by will appear ) it would glance according to the quality of the touch, and move from the stick in another line.

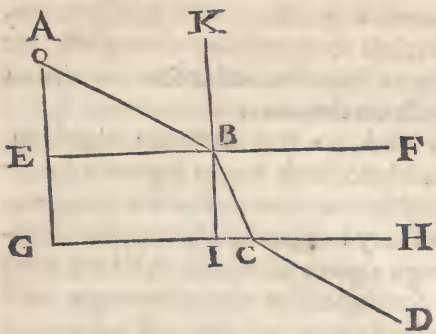
Some peradventure may answer for Monsieur Des Cartes that this subtile body which he supposeth to run through all things is stiffe and no wayes pliable. But that is so repugnant to the nature of rarity & so many insuperable inconveniencies do follow out of it; as I cannot imagine he will own it ; and therefore I will not spend any time in replying thereunto.

7. The true cause of refraction of light both at its entrance, & at its going out from the reflecting body.

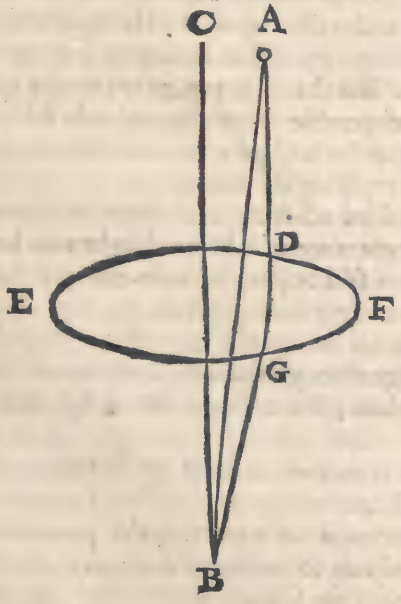
We must therefore seek some other cause of the refraction of light, which is made at the entrance of it into a diaphanous body. Which is plainly (as we said before) because the ray striking against the inside of a body it cannot penetrate, turneth by reflexion towards that side on which the illuminant standeth: and if it findeth clear passage through the whole resistent, it followeth the course it first taketh; if not, then it is lost by many reflections to and fro.

And that this doctrine is true, the accidents or Phenomenas evidently declare unto us; for experience teacheth us, that upon a plain superficies the refraction is made towards the penpendicular drawn from the illuminant to the superficies ; as we have said. Now at the going out ( if the surfaces be parallels ) we see that the ray turneth from that perpendicular; which also is necessary:

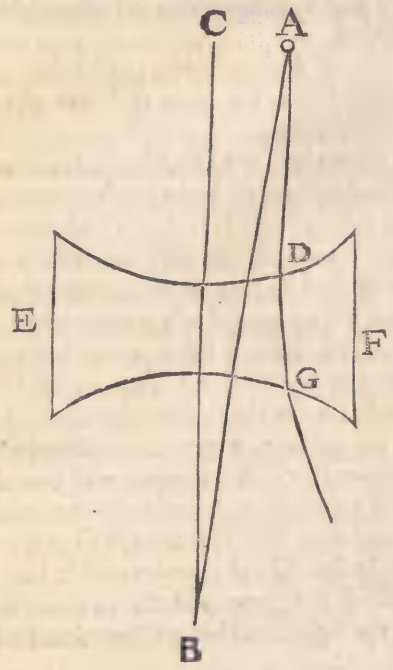
ceſſary; for going through a pore bigger then it ſelf, or at the leaſt as big; and finding it full of aire, it muſt needs be crowded there. But in a crowd, he preſſeth you moſt whō you preſſe moſt upon: ſo then that ſide of the pore which is next to the light as it paſſeth, muſt preſſe moſt upon it: but the angle wch is towards the perpendicular, to wit, the angle B C I, is the leſſer; & by conſequence, the ray is nearer that ſide of the pore which is towards I, then the other ſide of it wch is towards H; wherefore it muſt take its ply from that ſide. But that ſide ſtriketh it from the perpendicular: and therefore it muſt there refract from the perpendicular.




This very ſame doctrine for the reaſon of refraction is confirmed by what happeneth in crooked ſuperficieſes. As if E F be a *Lens* or a glaſſe on both ſides convex; and C B the axis of it; A D the ray falling from the illuminant A; A B the perpendicular falling frō the ſame illuminant A: it will be plain by the former diſcourſe, that the ray A D, muſt at the entry be refracted towards A B, as being repulſed from that part of the inſide of the pore D, which is towards F; becauſe that ſide is moſt oppoſed unto the ray. Now the ray being once turned that way; when at the end of its journey through the glaſſe



glasse, it is come to the other superficies E G F, it maketh the lesser angle towards F; and therefore must it by the rule given above be refracted again at its parting from the glasse, towards the same perpendicular ; and it will meet somewhere with the axis C B; all which experience sheweth us to be true.




And taking a body of concave surfaces we shall (according to this doctrine of ours) find the causes of refraction just contrary; & accordingly experience likewise sheweth us the effects to be so too. And therefore since experience agreeth exactly with our rules, we cannot doubt but that the principles upon which we go are well laid.

8. A generall rule to know the nature of reflexions and refractions in all sorts of surfaces.

But because crooked surfaces may have many irregularities; it will not be amisse to give a rule by which all of them may be brought unto a certainty. And this it is, that reflexions from crooked superficieses are equall to the reflexions that are made from such plain superficieses, as are tangents to the crooked ones in that point from whence the reflexions are made. Which principle the masters of Opticks do take out of a Mathematicall supposition of the unity of the reflecting point, in both the surfaces; the crooked and the plain: but we take it out of the insensibility of the difference of so little a part in the two different surfaces, as serveth to reflect a ray of light: for where the difference is insensible in the causes, there likewise the difference is so little in the effects, as sense cannot judge of them: which is as much as is requisite to our purpose. Now seeing that in the Mathematicall supposition, the point where the reflexion is made is indifferent

different to both the surfaces: it followeth, that it importeth not whether superficies you take to know the quality of reflexion by. This principle then being settled, that the reflexion must follow the nature of the tangent surfaces, and it being proved, that in plain surfaces it will happen in such sort as we have explicated, it followeth that in any crooked superficies of what figure soever the same also will happen.

Now seeing we have formerly declared, that refractions are but a certain kind of reflexions, what we have said here of reflexions may be applyed to refractions.

9. A body of greater parts and greater pores maketh a greater refraction then one of lesser parts and lesser pores.

But there remaineth yet untouched one affection more of refractions; which is that some diaphanous bodies do in their inward parts reflect more then others, (which is that which we call refraction) as experience sheweth us: concerning which effect, we are to consider that diaphanous bodies may in their composition have two differences: for some are composed of greater parts and greater pores; others, of lesser parts and lesser pores. It is true there may be other combinations of pores and parts, yet by these two the rest may be esteemed. As for the first combination, we see that because the pores are greater, a greater multitude of parts of light may passe together through one pore; and because the parts are greater, likewise a greater multitude of rayes may reflect from the same part, and may find the same passage quite throughout the diaphanous body. On the contrary side in the second combination where both the pores and the parts of the diaphanous body are little, the light must be but little that findeth the same passage.

Now that refraction is greater or lesser happeneth two wayes: for it is either when one diaphanous body reflecteth light at more angles then another, and by consequence in a greater extent of the superficies; or else when one body reflecteth light from the same point of incidence in a shorter line & in a greater angle then another doth. In both these wayes it is apparent that a body composed of greater parts and greater pores, exceedeth bodies of the opposite kind: for by reason that in the first kind more light may beat against one part; a body in which that happeneth, will make an appearance from a further part of its superficies: whereas in a body of the other sort, the light that beateth against one of the little parts of it will be so little as it will

will presently vanish. Again, because in the first, the part at the incidence is greater; the surface from which the reflexion is made inwards, hath more of a plain and straight superficies: and consequently doth reflect at a greater angle, then that, whose superficies hath more of inclining.

10. A confirmation of the former doctrine, out of the nature of bodies that refract light.

But we must not passe from this question, without looking a little into the nature of those bodies in which refraction is made: for if they, as well as the immediate causes of refraction, do likewise favour us; it will not a little advance the certainty of our determination. To this purpose we may call to mind, how experience sheweth us that great refractions are made in smoke, and in mists, and in glasses, and in thick-bodied waters; and Monsieur Des Cartes addeth certain oyles, and spirits or strong waters.

Now most of these we see are composed of little consistent bodies, swimming in another liquid body. As is plain in smoke and mists: for the little bubbles which rise in the water before they get out of it; and that are smoke when they get into the aire; do assure us that smoke is nothing else, but a company of little round bodies, swimming in the aire: and the round consistence of water upon herbs, leafs, and twigs in a rind or dew, giveth us also to understand that a mist is likewise a company of little round bodies that sometimes stand, sometimes float in the aire, as the wind driveth them. Our very eyes bear witnesse to us, that the thicker sort of waters are full of little bodies, which is the cause of their not being clear.

As for glasse, the blowing of it convinceth, that the little darts of fire which pierce it every way, do naturally in the melting of it convert it into little round hollow bodies, which in their cooling must settle into parts of the like figure. Then for crystall and other transparent stones which are found in cold places; it cannot be otherwise, but that the nature of cold piercing into the main body, and contracting every little part in it self, this contraction must needs leave vacant pores between part and part. And that such transparent stones as are made by heat, have the like effect and property, may be judged out of what we see in bricks and tiles, which are left full of holes by the operation of the fire. And I have seen in bones that have lain a long time in the sun, a multitude of sensible little pores close to one another, as if they had been formerly stuck all over with

with ſubtile ſharp needles as cloſe as they could be thruſt in by one another. The Chymicall oyles and ſpirits which Monſieur Des Cartes ſpeaketh of, are likely to be of the ſame compoſition; ſince that ſuch uſe to be extracted by violent fires: for a violent fire is made by the conjunction of many rayes together; and that muſt needs cauſe great pores in the body it worketh upon; and the ſticking nature of theſe ſpirits, is capable of conſerving them

Out of all theſe obſervations, it followeth, that the bodies in which greateſt refractions do happen, are compounded (as we have ſaid) of great parts, and great pores. And therefore, by onely taking light to be ſuch a body as we have deſcribed it to be, where we treated of the nature of it; it is evident, that the effect which we have expreſt, muſt neceſſarily follow by way of reflexion, and that refraction is nothing elſe but a certain kind of reflexion

Which laſt aſſertion, is likewiſe convinced out of this; that the ſame effects proceed from reflexion as from refraction: for by reflection a thing may be ſeen greater then it is; in a different place from the true one where it is: colours may be made by reflexion, as alſo gloating light; and fire likewiſe; and peradventure all other effects which are cauſed by refraction, may as well as theſe, be performed by reflexion. And therefore it is evident, they muſt be of the ſame nature; ſeeing that children are the reſemblances of their parents.

## CHAP. XIV.

*Of the compoſition, qualities, and generation of mixed bodies.*

1. The connexion of this chapter with the reſt, and the Authors intent in it.

HAving now declared the virtues by which fire and earth work upon one another, and upon the reſt of the elements; which is, by light, and by the motions we have diſcourſed of. Our task ſhall be in this chapter firſt to obſerve what will reſult out of ſuch action of theirs: and next, to ſearch into the wayes and manner of compaſſing and performing it. Which latter we ſhall the more eaſily attain unto, when we firſt know the end that their operation levelleth at. In this purſuit we ſhal find that the effect of the elements combinations, by means of the motions that happen among them; is a long pedigree of compounded qualities and bodies: wherein the firſt combinations (like marriages) are the breeders of the next more compoſed ſubſtances: and they again are the parents of others in greater variety:

variety: and so are multiplied without end; for the further this work proceedeth, the more subjects it maketh for new businesse of the like kind.

To descend in particular unto all these, is impossible. And to looke further then the generall heads of them, were superfluous and troublesome in this discourse; wherein I aime onely at shewing what sorts of things in common, may be done by bodies: that if hereafter we meet with things of another nature and strain, we may be sure they are not the ofspring of bodies and of quantity; which is the main scope of what I have designed here. And to do this with confidence and certainty, requireth of necessity this leisurely and orderly proceeding that hitherto we have used, and shall continue to the end: for walking thus softly, we have alwayes one foot upon the ground; so as the other may be sure of firm footing before it settle. Whereas, they that for more hast will leap over rugged passages and broken ground; when both their feet are in the aire, connot help themselves, but must light as chance throweth them.

To this purpose then we may consider, that the qualities of bodies in common are of three sorts: for they are belonging either to the constitution of a compounded body, or else to the operation of it; and the operation of a body, is of two kinds; the one, upon other bodies, the other, upon sense. The last of these three sorts of qualities, shall be handled in a peculiar chapter by themselves. Those of the second sort, whereby they work upon other bodies, have been partly declared in the former chapters, and will be further discoursed of in the rest of this first Treatise: so as that which remaineth for the present, is to fall upon the discourse of such qualities as concur to the constitution of bodies; with an aime to discover, whether (or no) they may be effected by the severall mixtures of rarity and density, in such sort as is already declared. To which end, we are to consider in what manner these two primary differences of bodies may be joyned together: and what effects such conjunction will produce.

As for their conjunction: to deliver the nature of it entirely, we must begin from the very root of it, and consider how the Universe being finite (which Mr. White hath demonstrated in the second knot of his first Dialogue) there cannot be an infinite number of bodies in it; for Geometricians shew us how the least

2. That there is a least size of bodies, and that this least size is found in Gre-

quantity that is, may be repeated so often as would exceed any the greatest determinate quantity whatsoever. Out of which it followeth, that although all the other bodies of the world were no bigger then the least quantity that can be designed; yet they being infinite in number, would be greater then the whole universe that containeth them. And therefore, of necessity there must be some least body, or rather, some least size of bodies: which in compounded bodies is not to be expected: for, their least parts being compounded, must needs include compounding parts lesse then themselves. We must then look for this least size of bodies in the Elements; which of all bodies are the simplest. And among them, we must pitch upon that, wherein is greatest divisibility, and which consequently is divided into least parts; that is, fire: so as we may conclude that among all the bodies in the world, that which of its own nature hath an aptitude to be least, must be fire.

3. The first conjunction of parts is in bodies of least size; and it is made by the force of Quantity.

Now, the least body of fire, be it never so little, is yet divisible into lesse. What is it then that maketh it be one? To determine this; we must resort unto the nature of *Quantity*: whose formall notion and essence is, *To be divisible*; which signifieth, that many may be made of it; but that of which many may be made, is not yet many, out of this very reason, that many may be made of it. But, what is not many, is one. Therefore what hath quantity; is, by mere having quantity, actually and formally as well one, as it hath the possibility of being made many. And consequently, the least body of fire, by having quantity, hath those parts which might be many, actually one. And this is the first conjunction of parts that is to be considered in the cõposition of bodies: wch though it be not an actuall joyning of actuall parts; yet it is a formal cõjunction of what may be many.

4. The second sort of conjunction is compactednesse in simple Elements, and it proceedeth from density.

In the next place we may consider; how seeing the least bodies that are, be of fire; it must needs follow, that the least parts of the other Elements must be bigger then they. And consequently, the possible parts of those least parts of the other Elements must have something to conserve them together, more then is found in fire. And this, because Elements are purely distinguished by rarity and density is straight concluded to be *density*. And thus we have found; that as quantity is the cause of the possible parts being one, so density is the cause of the like parts sticking

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together: which appeareth in the very definition of it, for, *to be lesse divisible*, (which is the notion of density) speaketh a resistance to division, or a sticking together.

Now let us examine how two parts of different Elements are joyned together, to make a compound. In this conjunction we find both the effects we have already touched: for, two such parts must make one; and moreover, they must have some resistance to divisibility. The first of these effects we have already assigned unto the nature of quantity. And it being the formall effect of quantity; it cannot (whersoever it is found) have any other formall cause then quantity: and therefore either the two little parts of different Elements, do not become one body: or if they do, we must agree that it is by the nature of quantity which worketh as much in heterogeneall parts, as it doth in homogeneall ones. And it must needs do so: because Rarity and Density (which are the proper differences of Quantity) cannot change the common nature of Quantity, that is their Genus: which by being so to them, must be univocally in them both. And this effect cometh precisely from the pure notion of the Genus: and consequently, must be seen as well in two parts of different natures, as in two parts of the same nature: but in parts of the same nature, which once were two, and afterwards become one; there can be no other reason why they are one, then the very same for which those parts that were never separated (but that may be separated) are likewise one: and this, most evidently, is the nature of quantity.

5. The third conjunction is of parts of different Elements, and it proceedeth from quantity and density together.

Experience seemeth to confirm thus much; when pouring water out of a basin, some of it will remain sticking to the sides of the metall: for if the quantity of the basin, and of the water, had not been one and the same by its own nature; the water (considering the pliablenesse of its parts) would certainly have commen all away, and have glided from the unevennesse of the basin, by the attractive unity of its whole, and would have preserved the unity of its quantity within it self, rather then by sticking to the basin, have suffered division in its own quantitie; which we are sure was one, whiles the water was altogether in the basin: but that both the basin and the water making but one quantity; and a division being unavoydable in that one quantity; it was indifferent, in regard of the quantity considered singly

by it self, where this division should be made, whether in the parts of the basin, or in the parts of the water: and then, the other circumstances determined it in that part of the water which was neareſt to the joyning of it with the basin.

The second effect (which was resistance to divisibility;) we assigned unto density. And of that same cause, must also depend the like effect in this case of the sticking together of the two parts of different Elements, when they are joyned to one another: for if the two parts, whereof one is dense, the other is rare, do not exceed the quantity of some other part of one homogeneall rare Element for the dividing whereof, such a determinate force and no lesse can suffice: then, seeing that the whole composed of these two parts is not so divisible as the whole consisting of that one part; the assigned force will not be able to divide them. Wherefore it is plain, that if the rare part had been joined to another rare part in steed of the dense one it is joyned unto, it had been more easily dividable from that, then now it is from the dense part. And by consequence it sticketh more closely to the dense part, then it would to another of its own nature.

6. The reason why liquid bodies do easily joyn together; and dry ones difficulty.

Out of what we have said, a step is made us to understand why soft and liquid bodies do easily joyn and incorporate into one continued body; but hard and dry bodies so difficultly, as by experience we find to be true. Water with water, or wine either with other wine or with water, so uniteth, that it is very hard to part them: but sand or stones cannot be made to stick together without very great force and industry. The reasons whereof, must necessarily depend of what we have said above. To wit, that two bodies cannot touch one another, without becoming one: and, that if two bodies of one degree of density do touch, they must stick together according to the force of that degree of density. Out of which two, is manifestly inferred, that if two hard things should come to touch, they must needs be more difficultly separated then two liquid things. And consequently, they cannot come to touch, without as much difficulty, as that whereby they are made one.

7. That no two hard bodies can touch one another immediately.

But to deduce this more particularly; let us consider, that all the little surfaces, by which one hard body may be conceived to touch another (as for example, when a stone lieth upon a stone) must of necessity be either plain, or concave, or convex. Now

if

if a plain superficies should be supposed to touch another plain one coming perpendicularly to it; it must of necessity be granted to touch it as soon in the middle as on the sides. Wherefore, if there were any aire (as of necessity there must be) betwixt the two surfaces before they touched; it will follow, that the aire which was in the middle must have fled quite out from between the two surfaces, as soon as any part of the surfaces do touch; that is, as soon as the aire which was between the utmost edges of the surfaces did fly out; and by consequence it must have moved in an instant.

But if a plain surface be said to touch a convexe surface; it toucheth it onely by a line, (as Mathematicians demonstrate) or onely by a point. But, to touch by a line or a point, is in truth, not to touch by the form or notion of Quantitie, which requireth divisibilitie in all that belongeth unto it;) and by consequence among bodies it is not to touch; and so, one such surface doth not touch the other.

Now, for a plain surface to touch a concave, every man seeth is impossible. Likewise for to convexe surfaces to touch one another, they must be allowed to touch either in a line or in a point, which we have shewed not to be a physicall touching. And if a convexe surface should be said to touch a concave; they must touch all at once as we said of plain surfaces; and therefore the same impossibility will arise therein: so that it is evident, that no two surfaces moving perpendicularly towards one another, can come to touch one another, if neither of them yieldeth, and changeth its hew.

Now then, if it be supposed that they come slidingly one over another in the same line; whereby, first the very tips of the edges come to touch one another; and still as you shoove the upermost on forwards, and that it slideth over more of the nether surface, it gaineth to touch more of it. I say that neither in this case do they touch immediately one another: for as soon as the two first parts should meet, if they did touch, and that there were no aire between them; they must presently become one quantity or body as we have declared; and must stick firmly together, according to their degree of density; and consequently could not be moved on without still breaking asunder at every impulse, as much of the massie body, as were already made one by their touching.

And if you should say they did not become one; and yet allow them to touch immediately one another without having any aire or fluide body between them; then if you suppose them to move onwards upon these termes; they would be changed locally, without any intrinsecall change: which in the book De Mundo (as we have formerly alledged) is demonstrated to be impossible.

There remaineth onely a third way for two hard surfaces to come together; which is, that first they should rest sloping one upon another, and make an angle where they meet (as two lines, that cut one another, do in their point of their intersection) and so contain as it were a wedge of aire between them; which wedge they should lessen by little and little, through their moving towards one another at their most distant edges (whiles the touching edges are like immoveable centers that the others turn upon) till at length they shut out all the aire, and close together, like the two legs of a compasse.

But neither is it possible that this way they should touch, for after their first touch by one line (which neither is in effect a touching, as we have shewed) no other parts of them can touch, though still they approch nearer and nearer, untill their whole surfaces do entirely touch at once: and therefore, the aire must in this case leap out in an instant a greater space, then if the surfaces came perpendicularly to one another; for here it must flie from one extremity to the other: whereas, in the former case, it was to go but from the middle to each side.

And thus it is evident, that no two bodies can arrive to touch one another, unlesse one of them at the least have a superficies plyable to the superficies of the other; that is, unlesse one of them be soft, which is, to be liquide in some degree. Seeing then, that by touching, bodies do become one; and that liquidity is the cause and means whereby bodies arrive to touch; we may boldly conclude that two liquide bodies do most easily and readily become one; and next to two such, a liquide and a hard body, are soonest united: but two hard ones most difficultly.

8. How mixed bodies are framed in generall.

To proceed then with our reflections upon the composition of bodies, and upon what resulteth out of the joyning and mixture of their first differences Rarity and Density; we see, how if a liquide substance happeneth to touch a dry body it sticketh easily there-

thereunto. Then consider, that there may be so small a quantity of such a liquide body, as it may be almost impossible for any naturall agent to divide it further into any lesse parts; and suppose that such a liquide part is between two dry parts of a dense body, and sticking to them both, becometh in the nature of a glew to hold them together: will it not follow out of what we have said, that these two dense parts will be as hard to be severed from one another, as the small liquide part by which they stick together is to be divided? So that, when the viscuous ligaments which in a body do hold together the dense parts, are so small and subtile, as no force we can apply unto them can divide them, the adhesion of the parts must needs grow then inseparable. And therefore, we use to moisten dry bodies, to make them the more easily be divided; whereas those that are overmoist are of themselves ready to fall in peices. And thus you see how in generall, bodies are framed.

Out of which discourse, we may ballance the degrees of solidity in bodies, for all bodies being composed of humide and dry parts, we may conceive either kind of those parts, to be bigger or lesser, or to be more rare or more dense. Now if the dry parts of any body be extreme little and dense; and the moist parts that joyn the dry ones together, be very great and rare; then that body will be very easie to be dissolved. But if the moist parts which glew together such extreme little and dense dry parts, be either lesser in bulk or not so rare; then the body composed of them will be in a stronger degree of consistence. And if the moist parts which serve for this effect, be in an excesse of littleness and withall dense; then, the body they compose will be in the highest degree of consistence that nature can frame.

9. The cause of the severall degrees of solidity in mixed bodies.

On the other side; if you glew together great dry parts, which are moderately dense and great, by the admixtion of humide parts that are of the least size in bulk, and dense withall; then the consistence will decrease from the height of it by how much the parts are greater, and the density lesse. But if unto dry parts of the greatest size, and in the greatest remissenesse of density, you adde humide parts that are both very great and very rare, then the composed body will prove the most easily dissolveable of all that nature affordeth.

10. The rule where-

After this, casting our eyes a little further towards the com-

unto are reduced all the severall combinations of Elements in compounding of mixed bodies.

position of particular bodies; we shall find still greater mixtures, the further we go; for as the first and simplest compounded bodies, are made of the foure Elements; so, others are made of these; and again a third sort of them: and so onwards, according as by motion, the parts of every one are broken in sunder, and mingled with others. Those of the first order, must be of various tempers according to the proportions of the Elements, whereof they are immediately made. As for example, such a proportion of fire to the other three Elements, will make one kind of simple body, and another proportion will make another kind: and so throughout, by various combinations and proportions among all the Elements.

In the effecting of which work, it will not be amisse to look a little upon nature; and observe how she mingleth and tempereth different bodies one with another, whereby she begetteth that great variety of creatures which we see in the world. But because the degrees of composition are infinite, according to the encrease of number, we will contain our selves within the common notions of excesse in the foure primary components; for if we should descend once to specifie any determinate proportions, we should endanger losing our selves in a wood of particular natures, which belong not to us at present to examine. Then taking the foure Elements as materials to work upon: let us first consider how they may be varied, that differing compositions may result out of their mixtures. I conceive that all the wayes of varying the elements in this regard, may be reduced to the severall sizes of bigness, of the parts of each Element, that enter into the composition of any body, and to the number of those parts: for certainly no other can be imagined, unlesse it were variety of figure.

But that cannot be admitted to belong in any constant manner to those least particles whereof bodies are framed; as though determinate figures were in every degree of quantity due to the natures of elements, and therefore, the elements would conserve themselves in those figures, as well in their least atomes, as in massie bulk: for seeing how these little parts are shuffled together without any order; and that all liquids easily joyn, and take the figures which the dense ones give them; and that they again, justling one another, do crush themselves into new shapes,

which

which their mixture with the liquid ones, maketh them yield the more easily unto: it is impossible that the elements should have any other naturall figure in these their least parts, then such as chance giveth them. But that one part must be bigger then another is evident; for the nature of rarity and density giveth it: the first of them causing divisibility into little parts, and the latter hindering it.

11. Earth and water are the basis of all permanent mixed bodies.

Having then settled in what manner the elements may be varied in the composition of bodies; let us now begin our mixture. In which our ground to work upon must be earth and water; for onely these two are the basis of permanent bodies, that suffer our senses to take hold of them, and that submit themselves to triall: whereas if we should make the predominant element to be aire or fire, and bring in the other two solid ones under their jurisdiction to make up the mixture, the compound resulting out of them would be either in continuall consumption (as ordinary fire is) or else imperceptible to our eyes or touch, and therefore not a fit subject for us to discourse of, since the other two afford us enough to speculate upon. Peradventure our smell might take some cognisance of a body so composed, or the effect of it taken in by respiration, might in time shew it self upon our health: but it concerneth not us now to look so far; our designe requireth more maniable substances.

12. What kind of bodies those are where water is the basis, and earth the predominant element over the other two.

Of which let water be the first; and with it we will mingle the other three elements, in excesse over one another by turns; but still all of them overswayed by a predominant quantity of water: and then let us see what kind of bodies will result out of such proportions. First, if earth prevail above fire and aire, and arrive next in proportion to the water, a body of such a composition must needs prove hardly liquid, and not easie to let its parts run asunder, by reason of the great proportion of so dense a body as earth that holdeth it together. Yet some inclination it will have to fluidnesse, by reason the water is predominant over all; which also will make it be easily divisible, and give very little resistance to any hard thing that shall be applyed to make way through it. In a word, this mixture maketh the constitution of mud, dirt, honey, butter, and such like things where the main parts are great ones. And such are the parts of earth and water in themselves.

Let

13. Of those bodies, where water being the basis, aire is the predominant Element.

Let the next proportion of excesse in a watry compound, be of aire, which when it prevaileth, it incorporateth it self chiefly with earth, for the other Elements would not so well retain it. Now, because its parts are subtile (by reason of the rarity it hath) and sticking, (because of its humidity) it driveth the earth and water likewise into lesser parts. The result of such a mixture is, that the parts of a body compounded by it are close, catching, flowing slowly, glibbe, and generally it will burn, and be easily converted into flame.

Of this kind, are those which we call oyly or unctuous bodies whose great parts are easily separated, (that is, they are easily divisible in bulk,) but the small ones very hardly. Next the smalnesse, and well-working of the parts, by means of the aires penetrating every dense one, & sticking close to every one of them, and consequently, joyning them without any unevennesse; causeth that there can be no ruggednesse in it; and therefore, it is glibbe: in like manner as we see plaster or starch become smooth when they are well wrought. Then, the humidity of it causeth it to be catching, and the shortnesse of every part, maketh that where it sticketh, itis not easily parted thence. Now, the rarity of aire next unto fire, admitteth it to be (of all the other Elements) most easily brought to the height of fire, by the operation of fire upon it. And therefore, oyles are the proper food of that Element. And accordingly we see, that if a drop of oyl be spilled upon a sheet of paper, and the paper be set on fire at a corner; as the fire cometh near the oyl, the oyl will disperse and spread it self upon the paper to a broader compasse then it had; which is, because the heat rarifyeth it; and so, in oyl it self, the fire rarifying the aire, maketh it penetrate the earthy parts adjoyned unto it, more then it did; and so subtilizeth them, till they be reduced to such a height as they are within the power of fire to communicate his own nature unto them: and thus, he turneth them into fire, and carrieth them up in his flame.

14. What kind of bodies result, where water is the basis, and fire the predominant Element

But if fire be predominant over earth and aire in a watry compound; it maketh the body so proportioned, to be subtile, rare, penetrative, hot in operation, light in weight, and subject to burn. Of this kind are all sorts of wines, and distilled spirits, commonly called strong waters or Aquavites; in Latine Aquæ ardentes.

ardentes. These will lose their virtues merely by remaining uncovered in the aire; for fire doth not incorporate strongly with water; but, if it find means, raiseth it self into the aire; as we see in the smoke of boyling water which is nothing else but little bodies of fire, that entring into the water, do rarifie some parts of it; but have no inclination to stay there, and therefore as fast as they can get out, they fly away; but the humide parts of the water, which they have rarified (being of a stickingnature) do joyn themselves unto them, and ascend in the aire as high as the fiery atomes have strength to carry them: which whenit faileth them that smoke falleth down in a dew, and so becometh water again as it was. All which one may easily discern in a glasse-vessell of water set over the fire; in which one may observe the fire come in at the bottome, and presently swim up to the top like a little bubble, and immediately rise from thence in smoke; and that will at last convert it self into drops and settle upon some solid substance thereabouts.

Of these fiery spirits, some are so subtile, as of themselves they will vanish, and leave no residue of a body behind them; and Alchymists professe to make them so etheriall and volatile, that being poured out of a glasse from some reasonable height, they shall never reach the ground: but that before they come thither, they will be so rarified by that little motion, as they shall grow invisible like the aire, and dispersing themselves all about in it, they will fill the chamber with the smell of that body which can no longer be seen.

15. Of those bodies, where water is in excesse, it alone being both the basis, and the predominant Element.

The last excesse in watery bodies, must be of water it self, wch is, when so little a proportion of any of the other is mingled with it, as is hardly perceptible: out of this compofition do arise all those severall sorts of juices or liquors, which we commonly call waters: which by their mixture with the other three Elements, have peculiar properties beyond simple Elementall water. The generall qualitie whereof, we shall not need any further to expresse, because by what we have already said of water in common, they are sufficiently known.

16. Of those bodies where Earth alone is the basis, and also the predominant in excesse over the other three Elements.

In our next survey, we will take earth for our ground to work upon, as hitherto we have done water: wch if in any body, it be in the utmost excesse of it beyond all the other three: then rocks and stones will grow out of it; whose drinesse and hardnesse may assure

assure us, that earth swayeth in their composition, with the least allay that may be. Nor doth their lightnesse (in respect of some other earthy compositions) impeach this resolution; for that proceedeth from the greatnesse and multiplicity of pores, wherewith their drinesse causeth them to abound; and hindereth not, but that their reall solid parts may be very heavie.

17. Of those bodies where earth is the basis, & water the predominant element over the other two.

Now if we mingle a considerable proportion of water with earth, so as to exceed the fire and aire, but still inferiour to the earth; we shall produce metalls; whose great weight with their ductility and mallcability, plainly telleth us, that the smalleſt of waters grosse parts, are the glew that holdeth the earthy dense ones together: such weight belonging to earth, and that easie changing of parts, being most proper to water. Quicksilver (that is the generall matter whereof all the metalls are immediately composed) giveth us evidence hereof; for fire worketh upon it with the same effect as upon water. And the calcination of most of the metalls, proveth that fire can easily part and consume the glew by which they were closed and held together: which therefore must be rather of a watry then of an aiery substance. Likewise the glibnesse of Mercury, and of melted metalls, without catching or sticking to other substances, giveth us to understand that this great temper of a moist element with earth is water, and not aire; and that the watry parts are comprised, and as it were shut up within the earthy ones: for aire catcheth and sticketh notably to all things it toucheth, and will not be imprisoned; the divisibility of it being exceeding great, though in never so short parts.

18. Of those bodies where earth being the basis aire is the predominant.

Now if aire mingleth it self with earth, and be prodominant over water and fire; it maketh such an oily and fat soil, as husbandmen account their best mould; which receiving a betterment from the sunne and temperate heat, assureth us of the concourse of the aire: for whereseever such heat is, aire cannot fail of accompanying it, or of being effected by it; and the richest of such earth (as pot-earth and marl) will with much fire grow more compacted, and stick closer together then it did; as we see in baking them into pots or fine bricks. Whereas if water were the glew between the dense parts, fire would consume it and crumble them asunder, as it doth in those bodies it calcineth. And excesse of fire will bring them to vitrification; which still con-

confirmeth that aire aboundeth in them; for it is the nature of aire to stick so close where once it is kneaded in, as it cannot be separated without extreme difficulty. And to this purpose the viscuous holding together of the parts of glasse when it is melted, sheweth evidently that aire aboundeth in vitrified bodies.

19. Of those bodies where earth being the basis fire is the predominant.

The last mixture we are to meddle with, is of fire with earth, in an overruling proportion over aire and water. And this I conceive produceth those substances, which we may term coagulated juyces, and which the Latines do call *succi concreti:* whose first origine seemeth to have been liquours, that have been afterwards dried by the force either of heat or of cold. Of this nature are all kind of salts, niters, sulfurs, and divers sorts of bitumens. All which easily bewray the relicks and effects of fire left in them, some more some lesse according to their degrees.

20. All the second qualities of mixed bodies, arise from severall combinations of the first qualities: and are at last resolved into severall degrees of rarity and density.

And thus we have in generall deduced from their causes the complexions of those bodies, whereof the bulk of the world subjected to our use, consisteth; and which serve for the production and nourishment of living creatures, both animal and vegetable. Not so exactly (I confesse) nor so particularly, as the matter in it self, or as a Treatise confined to that subject, would require: yet sufficiently for our intent. In the performance whereof, if more accurate searchers of nature shall find that we have peradventure been mistaken in the minute delivering of some particular bodies complexion; their very correction (I dare boldly say) will justifie our principall scope: which is, to shew that all the great variety we see among bodies ariseth out of the commixtion of the first qualities and of the Elements: for they will not be able to correct us upon any other grounds then those we have laid.

As may easily be perceived, if we cast a summary view upon the qualities of composed bodies. All which we shall find to spring out of rarity and density, and to savour of their origine: for the most manifest qualities of bodies may be reduced to certain pairs opposite to one another. As namely some are liquid and flowing, others are consistent; some are soft, others hard, some are fatty, viscuous, and smooth, others lean, gritty, and rough; some grosse, others subtile; some tough, others brittle: and the like. Of which, the liquid, the soft, the fat, and the viscuous, are so manifestly derived from rarity, that we need not take

take any further pains to trace out their origine: and the like is of their contraries from the contrary cause; to wit, of those bodies that are consistent, hard, lean, and gritty, all which do evidently spring from density. As for smoothnesse, we have already shewed how that proceedeth from an aiery or oily nature; and by consequence, from a certain degree of rarity. And therefore roughnesse (the contrary of it) must proceed from a proportionable degree of density. Toughnesse is also a kind of ductility, which we have reduced to watrinesse, that is, to another degree of rarity; and consequently brittlenesse must arise from the contrary degree of density. Lastly, grossenesse and subtilnesse do consist in a difficulty or facility to be divided into small parts, which appeareth to be nothing else but a certain determination of rarity and density. And thus we see how the severall complexions of bodies are reduced to the foure elements that compound them: and the qualities of those bodies, to the two primary differences of quantative things by which the elements are diversified.

21. That in the planets & starrs there is a like varietyof mixed bodies caused by light as here upon earth.

And out of this discourse it will be evident, that these complexions and qualities, though in diverse degrees, must of necessity be found whereseever there is any variation in bodies: for seeing there can be no variation in bodies, but by rarity and density; and that the pure degrees of rarity and density do make heat, cold, moisture, and drinesse, and (in a word) the foure elements; it is evident, that whereseever there is variety of bodies, there must be the foure Elements; though peradventure far unlike these mixed bodies which we call elements. And again, because these elements cannot consist without motion; and because by motion they do of necessity produce mixed bodies, and forge out those qualities which we come from explicating; it must by like necessity follow, that whereseever there is any variety of active and passive bodies; there mixed bodies likewise must reside of the same kinds, and be indued with qualities of the like natures, as those we have treated of; though peradventure such as are in other places of the world remote from us, may be in a degree far different from ours.

Since then it cannot be denied, but that there must be notable variety of active and passive bodies whereseever there *is light:* neither can it be denied but that in all those great bodies from which

which light is reflected unto us, there must be a like variety of complexions and of qualities, and of bodies tempered by them, as we find here in the orb we live in. Which systeme, how different it is from that which Aristotle and the most of the school have delivered us, as well in the evidencies of the proofs for its being so; as in the position and modell of it; I leave unto the prudent readers to consider and judge.

22. In what manner the elements do work upon one another, in the composition of mixed bodies: and in particular fire which is the most active

Out of what hath been already said, it is not hard to discover in what manner the composition of bodies is made. In effecting of which, the main hinge whereon that motion dependeth is fire or heat: as it likewise is in all other motions whatsoever. Now because the composition of a mixed body, proceedeth from the action of one simple body or element upon the others; it will not be amisse to declare by some example how this work passeth: for that purpose let us examine how fire or heat worketh upon his fellows.

By what we have formerly delivered, it is clear that fire streaming out from its center, and diffusing it self abroad, so as to fill the circumference of a larger circle, it must needs follow, that the beams of it are most condensed and compacted together near the center; and the further they stream from the center, the more thin and rarified they must grow: yet this is with such moderation, as we cannot any where discern that one beam doth not touch another; and therefore the distances must be very small. Now let us suppose that fire happeneth to be in a viscuous & tenacious body; and then consider what will happen in this case: of one side, the fire spreadeth it self abroad; on the other side, the parts of the tenacious body being moist (as we have formerly determined) their edges on all hands will stick fast to the dry beams of the fire that passe between them. Then they stretching wider and wider from one another, must needs draw with them the parts of that tenacious body which stick unto them; and stretch them into a greater wideneſse or largenes then they enjoyed before, from whence it follows, that (seeing there is no other body near thereabouts but they two) either there must be a vacuity left, or else the tenacious body must hold and fill a greater space then it did before, and consequently be more rare.

Contrariwise, if any of the other elements be stronger then fire, the denser elements break off from their continued stream the little

little parts of fire which were gotten into their greater parts: and sticking on all sides about them, they do so enclose them that they have no more semblance of fire: and if afterwards by any accident there cometh a great compression, they force them to lose their naturall rarity, and to become some other Element. Thus it fareth with fire, both in acting and in suffering. And the same course, we have in both these regards expressed of it, passeth likewise in the rest of the Elements to the proportion of their contrarieties.

Hence it followeth that when fire meeteth with humidity in any body, it divideth and subtiliseth it, and dispersеth it gently, and in a kind of equall manner through the whole body it is in, (if the operation of it be a naturall and a gentle one) and so driveth it into other parts, which at the same time it prepareth to receive it by subtilising likewise those parts. And thus moderate fire, maketh humour in very small parts to incorporate it self in an even or uniform manner with the dry parts it meeteth withall: which being done whether the heat doth afterwards continue, or that cold succeedeth in lieu of it, the effect must of necessity be, that the body thus composed, be bound up and fastened, more or lesse according to the proportion of the matter it is made of, and of the Agents that work upon it, and of the time they employ about it. This is every day seen, in the ripening of fruits and in other frequent works, as well of art as of nature, and is so obvious, and sensible to any reasonable observation that it is needles to enlarge my self much upon this subject

23. A particular declaration touching the generation of metalls.

Onely, it will not be amisse, for examples sake, to consider the progresse of it in the compoſing or augmenting of metalls, or of earths of divers sorts: first heat (as we have said) draweth humour out of all the bodies it worketh upon: then if the extracted humour be in quantity and the steams of it do happen to come together in some hollow place, fit to assemble them into greater parts; they are condensed and they fall down in a liquid and running body. These steams being thus corporified, the body resulting out of them, maketh it self in the earth a channell to runne in: and if there be any loose parts in the channell, they mingle themselves with the running liquour: and though there be none such, yet in time the liquour it self loosеneth the channell all about, and imbibeth into its own substance the

the parts it raiseth. And thus, all of them compacted together, do roll along till they tumble into some low place, out of which they cannot so easily get to wander further. When they are thus settled, they do the more easily receive into them, and retain such heat as is every where to be met withall, because it is diffused more or lesse through the earth. This heat if it be sufficient digesteth it into a solide body: the temper of cold likewise concurring in its measure to this effect. And according to the variety of the substances whereof the first liquour was made, and which it afterwards drew along with it; the body that resulteth out of them is diversified. In conconfirmation of all which they that deal in mines tell us they use to find metalls oftentimes mingled with stones; as also coagulated juyces with both; and earths of divers natures with all three; and they with it, and one with another among themselves. And that sometimes they find the mines not yet consolidated and digested throughly into metall; when by their experience knowing after how many yeares they will be ripe, they shut them up again till then.

Now if the hollow place wherein the body stayed (which at the first was liquid and rolling) be not at once filled by it, but it taketh up onely part of it; and the same liquour continueth afterwards to flow thither: then this body is augmented, and groweth bigger and bigger. And although the liquours should come at severall times, yet they become not therefore two severall bodies, but both liquours do grow into one body: for the wet parts of the adventitious liquour do mollifie the sides of the body already baked; and both of them being of a like temper and cognation, they easily stick and grow together.

Out of this discourse it followeth evidently, that in all sorts of compounded bodies whatsoever, there must of necessity be actually comprised sundry parts of divers natures: for otherwise, they would be but so many pure degrees of rarity and density; that is, they would be but so many pure elements, and each of them have but one determinate virtue or operation.

## CHAP. XV.

### *Of the dissolution of mixed bodies.*

THus much for composition of bodies. Their dissolution is made three wayes; either by fire, or by water, or by some out-

1. Why some bodies are brittle,

& others tough or apt to withstand outward violence, the first instrument to dissolve mixed bodies.

outward violence. We will begin with examining how this last is done: to which end we may consider, that the unity of any body consisting in the connexion of its parts; it is evident that the force of motion if it be exercised upon them, must of necessity separate them, as we see in breaking, cutting, filing, drawing asunder, and the like.

All these motions, because they are done by grosse bodies, do require great parts to work upon, and are easily discerned how they work: so that it is not difficult to find the reason why some hard bodies break easily, and others with much ado. The first of which are called brittle, the others tough. For if you mark it, all breaking requireth that bending should precede; which on the one side compresseth the parts of the bended body, & condenseth them into a lesser room then they possessed before; and on the other side stretcheth them out, and maketh them take up more place. This requireth some fluid or moveable substance to be within the body, else it could not be done; for without such help the parts could not remove. Therefore such hard bodies as have most fluid parts in them, are most flexible, that is, are toughest. And those which have fewest, though they become thereby hardest to have impression made upon them, yet if the force be able to do it, they rather yield to break then to bend, & thence are called brittle.

Out of this we may infer, that some bodies may be so suddenly bent as that thereby they break asunder; whereas if they were leisurely and gently dealt withall, they would take what ply one desireth. And likewise that there is no body (be it never so brittle and hard) but that it will bend a little (and indeed more then one would expect) if it be wrought upon with time & dexterity; for there is none but containeth in it some liquid parts more or lesse; even glasse and brick. Upon which occasion I remember, how once in a great storme of wind, I saw the high slender brick chimneys of the Kings house at S. James (one winter when the Court lay there) bend from the wind like boughs, and shake exceedingly and totter. And at other times I have seen some very high and pointy spire steeples do the like. And I have been assured the like of the whole pile of a high castle, standing in a gullet in the course of the wind (namely the castle of Wardour) by those who have often seen it shake notably in a fierce wind.

The

The reason of all which may be deduced out of what we have said above: for seeing that the bending of a body maketh the spirits or humours that are within it to sally forth; it is clear that if the violence which forceth it be not so sudden, nor the motion it receiveth be not so quick, but that the moisture may ooze gently out; the body will bend still more and more, as their absence giveth it leave. But if the motion that is wrought in it be too quick, then the spirits not having time allowed them to go leisurely and gently out, do force their prison, and break out with a violence, and so the body is snapped into two.

2. How outward violence doth work upon the most compacted bodies.

Here peradventure some remembring what we have said in another place; namely, that it is the shortnesse and littlenesse of the humid parts in a body which maketh it stick together; and that this shortnesse may be in so high a degree, as nothing can come between the parts they glew together to divide them; may ask, how a very dense body of such a strain, can be broken or divided? But the difficulty is not great, for seeing that the humide parts in whatsoever degree of shortnesse they be, must necessarily have still some latitude; it cannot be doubted but there may be some force assigned greater then their resistance can be. All the question is, how to apply it to work its effect upon so close a compacted body, in which peradventure the continuity of the humid parts that bind the others together, may be so small as no other body whatsoever (no, not fire) can go between them, in such sort as to separate part from part. At the worst, it cannot be doubted but that the force may be so applyed at the outside of that body, as to make the parts of it presse and fight one against another, and at the length by multiplication of the force, constrain it to yield and suffer division. And this I conceive to be the condition of gold and of some precious stones: in which the elements are united by such little parts, as nothing but a civill warre within themselves (stirred up by some subtile outward enemy, whereby they are made to tear their own bowels) could bring to passe their destruction.

But this way of dissolving such bodies, more properly belongs to the next way of working upon thē by fire: yet the same is done when some exteriour violence pressing upon those parts it toucheth, makes them cut a way betwixt their next neighbours; & so continuing the force divide the whole body. As when the chisell

or even the hammer with beating, breaketh gold asunder: for it is neither the chisell, nor the hammer that doth that effect immediately; but they make those parts they touch, cut the others that they are forced upon. In such sort as I remember happened to a gentleman that stood by me (in a sea-fight I was in) with a coat of mail upon his body, when a bullet coming against a bony part in him, made a great wound, and shattered all the bones near where it struck: and yet the coat of mail was whole: it seemeth the little links of the mail yielding to the bullets force made their way into the flesh and to the bone.

3. The severall effects of fire, the second and chiefest instrument to dissolve all compounded bodies.

But now it is time to come to the other two instruments of separation of bodies, fire and water; and to examine how they dissolve compounds. Of these two; the way of working of fire, is the easiest and most apparant to be discerned. We may readily observe how it proceedeth, if we but set a piece of wood on fire; in which it maketh little holes as if with bodkins it pierced it. So that the manner of its operation in common being plain, we need but reflect a little upon the severall particular degrees of it. Some bodies it seemeth not to touch; as clothes made of Asbestus; which are onely purifyed by it. Others, it melteth, but consumeth not; as gold. Others it turneth into powder suddainly dissolving their body; as lead, and such metalls as are calcined by pure fire. Others again, it separateth into a greater number of differing parts; as into spirits, waters, oyls, salts, earth and glasse: of which rank are all vegetables. And lastly, others it converteth into pure fire, as strong waters, or Aquavites (called aquæ ardentes) and some pure oyls: for the smoke that is made by their setting on fire, and peradventure their salt is so little as is scarce discernable. These are in summe the divisions which fire maketh upon bodies, according to the nature of them, and to the due application of it unto them: for by the help & mediation of other things, it may peradventure work other effects

4. The reason why some bodies are dissolved by fire.

Now to examine a little in particular, how the same fire, in differing subjects, produceth such different effects: *Limus ut hic durescit, & hæc ut cera liquescit, Uno eodémque igni;*

We will consider the nature of every one of the subjects apart by it self. First, for the Asbestus: it is clear, that it is of a very dry substance; so that to look upon it, when it is broken into very little pieces, they seem to be little bundles of short hairs,

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the liquidity within, being so little as it affordeth the parts neither length nor breadth: and therefore, fire meeteth with little there that it can dilate. But what it cannot dilate, it cannot separate; nor carry away any thing of it, but what is accidentally adherent unto the outsides of it. And so it seemeth onely to passe through the pores, and to cleanse the little thrids of it: but bringeth no detriment at all to the substance of it. In this I speak onely of an ordinary fire: for I doubt not but such a one it might be, as would perfectly calcine it.

5. The reason why fire melteth gold but cannot consume it.

The next body we spoke of is gold. This aboundeth so much in liquidity, that it sticketh to the fire, if duely applyed: but its humidity is so well united to its earthy parts, and is so perfectly incorporated with them; as it cannot carry away one, without likewise carrying away both: but both, are too heavy a weight for the little agile parts of fire to remove. Thus, it is able to make gold swell; as we see in melting it: in which, the gold receiveth the fire into its bowels and retaineth it a long time with it: but at its departure, it permitteth the fire to carry nothing away upon its wings: as is apparant, by the golds no whit decay of weight, after never so long fusion. And therefore, to have fire make any separation in gold, requireth the assistance of some other moist body, that on the one side may stick closely to the gold, when the fire driveth it into it, and on the other side may be capable of dilatation, by the action of the fire upon it. As in some sort we see in strong waters made of salts, which are a proper subject for the fire to dilate, who, by the assistance of fire, mingling themselves closely with little parts of the gold, do pull them away from their whole substance, and do force them to bear them company in their journey upwards, in which, multitudes of little parts of fire, do concurre to presse them on and hasten them: and so, the weight of gold being at length overcome by these two powerfull Agents (whereof one supplyeth, what the other wanteth) the whole substance of the metall, is in little atomes diffused through the whole body of the water. But this is not truly a dissolution or a separation of the substantiall parts of gold, one from another: it is onely a corrosion, which bringeth it into a subtile pouder, (when the water & salts are separated from it) much like what filing (though far smaller) or grinding of leaf gold upon a porphyre stone, may reduce it into: for neither the

parts of the water, nor of the fire that make themselves away into the body of the gold, are small and subtile enough to get between the parts that compose the essence of it: and therefore all they can attain unto, is to divide it onely in his quantity or bulk, not in the composition of its nature.

Yet I intend not to deny but that this is possible to be arrived unto, either by pure fire duly applyed. or by some other assistance; as peradventure by some kind of Mercury; which being of a nearer cognation unto metalls then any other liquour is, may happily have a more powerfull ingression into gold then any other body whatsoever; and being withall very subject to rarefaction, it may (after it is entered) so perfectly penetrate the gold, as it may separate every least part of it, and so reduce it into an absolute calx. But in this place I explicate no more then what ordinarily passeth, leaving the mysteries of this art to those who professe it.

6. Why lead is easily consumed and calcined by fire.

To go on then with what we have in hand: lead hath abundance of water overmingled with its earth, as appeareth by its easie yielding to be bent any way, and by its quiet standing bent in the same position that the force which bowed it leaveth it in. And therefore the liquid parts of lead, are easily separated from its dry and earthy ones: and when it is melted, the very shaking of it, causeth the grosse parts to descend, and many liquid ones to flie away with the fire; so that suddenly it is thus converted into powder. But this powder is grosse in respect of other metalls; unlesse this operation be often reiterated, or the fire more powerfully applyed, then what is just enough to bring the body of the lead into powder.

7. Why and how some bodies are divided by fire into spirits, waters, oyles, salts, and earth. And what those parts are.

The next consideration of bodies that fire worketh upon, is of such as it divideth into spirits, salts, oyles, waters, or phlegms, and earth. Now these are not pure and simple parts of the dissolved body, but new compounded bodies made of the first by the operation of heat. As smoke is not pure water, but water and fire together: and therefore becometh not water but by cooling, that is, by the fire flying away from it. So likewise those spirits, salts, oyls, and the rest; are but degrees of things which fire maketh of diverse parts of the dissolved body, by separating them one from another, and incorporating it self with them. And so they are all of them compounded of the foure elements, and are further resolvable into them. Yet

Yet I intend not to say that there are not originally in the body before its dissolution, some loose parts which have the properties of these bodies that are made by the fire in the dissolving of it: for seeing that nature worketh by the like instruments as art useth, she must needs in her excesses and defects produce like bodies to what art doth in dissolution; which operation of art is but a kind of excesse in the progresse of nature: but my meaning is, that in such dissolution there are more of these parts made by the working of fire, then were in the body before.

Now because this is the naturall and most ordinary dissolution of things; let us see in particular how it is done: suppose then that fire were in a convenient manner applyed to a body that hath all sorts of parts in it; and our own discourse will tell us, that the first effect it worketh will be, that as the subtile parts of fire do divide and passe through that body, they will adhere to the most subtile parts in it; which being most agile and least bound and incorporated to the bowels of the body, and lying (as it were) loosely scattered in it, the fire will carry them away with it. These will be the first that are separated from the main body; which being retained in a fit receiver, will by the coldnesse of the circumdant aire grow outwardly cool themselves, and become first a dew upon the sides of the glasse, and then still as they grow cooler, condense more and more; till at the length they fall down congealed into a palpable liquour; which is composed (as you see) of the hottest parts of the body, mingled with the fire that carried them out: and therefore this liquour is very inflammable, and easily turned into actuall fire; as you see all spirits and *Aquæ ardentes* of vegetables are.

The hot and loose parts being extracted, and the fire continuing and encreasing, those that will follow next are such as though they be not of themselves loose, yet are easiest to be made so; and are therefore most separable. These must be humide, and those little dry parts which are incorporated with the overflowing humide ones in them (for no parts that we can arrive unto are of one pure simple nature; but all are mixed and compo'ed of the foure elements in some proportion) must be held together with such grosse glew as the fire may easily penetrate and separate them. And then the humide parts divided into little atomes do stick to the lesser ones of the fire: which by their multitude

of number and velocity of motion, supplying what they want of them in bulk; do carry them away with them. And thus these phlegmatick parts flie up with the fire and are afterwards congealed into an insipide water: which if it have any savour, is because the first ardent spirits are not totally separated from it, but some few of them remain in it, and give some little life to the whole body of that otherwise flat liquour.

Now those parts which the fire separateth next from the remaining body, after the fiery and watry ones are carried away, must be such as it can work upon: and therefore must abound in humidity. But since they stir not till the watry ones are gone it is evident that they are composed of many dry parts strongly incorporated, and very subtilly mixed with the moist ones; & that both of them are exceeding small, and are so closely and finely knit together, that the fire hath much ado to get between them, and cut the thrids that tie them together: and therefore they require a very great force of fire to carry them up. Now the composition of these sheweth them to be aeriall: and (together with the fire that is mingled with them) they congeal into that consistence which we call oyl.

Lastly, it cannot be otherwise but that the fire, in all this while of continuall application to the body it thus anatomiseth, hath hardened, and as it were rosted some parts into such greatnesse and drinesse as they will not flie, nor can be carried up with any moderate heat. But great quantity of fire being mingled with the subtiler parts of his baked earth maketh them very pungent and acrimonious in taste: so that they are of the nature of ordinary salt, and are so called; and by the help of water may easily be separated from the more grosse parts which then remain a dead and useless earth.

By this discourse it is apparent, that fire hath been the instrument which hath wrought all these parts of an entire body into the forms they are in; for whiles it carried away the fiery parts, it swelled the watry ones; and whiles it lifted up them it digested the aeriall parts, and whiles it drove up the oyls, it baked the earth and salt. Again, all these retaining for the most part, the proper nature of the substance from whence they are extracted; it is evident that the substance is not dissolved; (for so the nature of the whole would be dissolved and quite destroyed & extinguished

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in every part ) but that onely some parts containing the whole substance, or rather the nature of the whole substance in them, are separated from other parts that have likewise the same nature in them.

8. How water the third instrument to dissolve bodies, dissolveth calx into salt, and so into *Terra damnata.*

The third instrument for the separation and dissolution of bodies is water, whose proper matter to work upon is salt. And it serveth to supply what the fire could not perform, which is the separation of the salt from the earth in calcined bodies. All the other parts fire was able to sever, but in these he hath so baked the little humidity he hath left in them with their much earth; as he cannot divide them any further. And so though he incorporateth himself with them, yet he can carry nothing away with him. If then pure water be put upon that chalk, the subtilest dry parts of it do easily joyn to the supervenient moysture, & sticking close to it do draw it down to them: but because they are the lighter, it happeneth to them as when a man in a boat pulleth the land to him; that cometh not to him, but he removeth himself and his boat to it: so these ascend in the water as they dissolve. And the water more and more penetrating them, and by addition of its parts making the humidity which gleweth their earthy parts together greater and greater, doth make a wider and wider separation between those little earthy parts; and so imbueth the whole body of the water with them, into which they are dispersed in little atomes. Those that are of biggest bulk remain lowest in the water. And in the same measure as their quantities dissolve into lesse and lesse, they ascend higher and higher in the water; till at the length the water is fully repleniſhed with them, and they are diffused through the whole body of it: whiles the more grosse and heavie earthy parts (having nothing in them to make a present combination between them and the water) do fall down to the bottom, and settle under the water in dust.

In which because earth alone doth predominate in a very great excesse, we can expect no other virtue to be in it, but that which is proper to mere earth; to wit, drinesse and weight. Which ordinary Alchymists look not after: and therefore call it *terra damnata:* but others find a fixing quality in it, by which they perform very admirable operations. Now if you poure the impregnated water from the *terra damnata,* and then evaporate

porate it, you will find a pure white substance remaining: Which by its bulk sheweth it self to be very earthy, and by its pricking, and corrosive taste, will inform you much fire is in it, and by its easie dissolution in a moist place, that water had a great share in the production of it. And thus the salts of bodies are made and extracted.

9. How water mingled with salt, becometh a most powerfull Agent to dissolve other bodies.

Now as water doth dissolve salt, so by the incorporation and virtue of that corrosive substance it doth more then salt it self can do: for having gotten acrimony, and more weight by the mixture and dissolution of salt in it, it maketh it self a way into solide bodies, even into metalls; as we see in brasse and iron; which are easily rusted by salt dissolving upon them. And according as the salts are stronger, so this corrosive virtue encreaseth in them, even so much, as neither silver nor gold are free from their eating quality. But they, as well as the rest, are divided into most small parts, and are made to swimme in water, in such sort as we have explicated above, and whereof every ordinary Alchymist teacheth the practise.

But this is not all; salts do help as well to melt hard bodies and metalls, as to corrode them: for some fusible salts flowing upon them by the heat of the fire, and others dissolved by the steam of the metall that incorporateth with them; as soon as they are in fluxe, they mingle with the naturall juice of the metall, and penetrate them deeper, then without them the fire could do, and swell them and make them fit to run.

10. How putrefaction is caused.

These are the principall wayes of the two last instruments in dissolving of bodies; taking each of them by it self. But there remaineth one more of very great importance, as well in the works of nature as of art; in which, both the former are joyned and do concurre: and that is putrefaction. Whose way of working is by gentle heat and moisture to wet and pierce the body it worketh upon; whereby, it is made to swell: and the hot parts of it, being loosened, they are at length drunk up and drowned in the moist ones (from whence, by fire they are easily separated as we have already declared;) and those moist parts, afterwards leaving it, the substance remaineth dry, and falleth in pieces, for want of the glew that held it together.

CHAP.

## CHAP. XVI.

*An explication of certain Maximes touching the operations and qualities of bodies: and whether the Elements be found pure in any part of the world.*

OUt of what we have determined, concerning the naturall actions of bodies, in their making and destroying one another; it is easie to understand the right meaning of some terms, and the true reason of some maximes much used in the schools. As first; when Philosophers attribute unto all sorts of corporeall Agents, a *Sphere of Activitie*. The sense of that manner of expression, in fire appeareth plainly, by what we have already declared of the nature and manner of operation of that Element.

I. What is the sphere of activity in corporeall Agents.

And in like manner, if we consider how the force of cold consisteth in a compression of the body that is made cold, we may perceive that if in the cooled body there be any subtile parts which can break forth from the rest, such compression will make them do so. Especially, if the compression be of little parts of the compressed body within themselves, as well as of the outward bulk of the whole body round about: for at first the compression of such causeth in the body, where they are, little holes or pores in the places they are compressed and driven from; which pores they filled up when they were dilated at their own naturall liberty. But being thus forcibly shrunk up into lesse room, afterwards, they squeese again out of their crowd all such very loose and subtile parts (residing till then with them) as can find their way out from among them. And these subtile parts that thus are delivered from the colds compression, get first into the pores that we have shewed were made by this compression. But they cannot long stay there; for the atomes of advenient cold that obsesse the compressed body, do likewise with all their force throng into those pores, and soon drive out the subtile guests they find there, because they are more in number, bigger in bulk, and more violent in their course then they. Who therefore must yield unto them the little channels, and capacities they formerly took up. Out of which they are thrust with such an impetuositie, that they spinne from them with a vehemence, as quick-

quicksilver doth through leather, when to purifie it, or to bring an Amalgame to a due consistence, it is strained through the sides of it.

Now these showrs or streams of atomes issuing from the compressed body, are on all sides round about it at exceeding little distances; because the pores out of which they are driven, are so likewise. And consequently, there they remain round about besieging it, as though they would return to their originall homes, as soon as the usurping strangers that were too powerfull for them, will give them leave. And according to the multitude of them, and to the force with which they are driven out; the compasse they take up round about the compressed body, is greater or lesser. Which besieging atomes are not so soon carried away by any exterior and accidentall causes, but they are supplied by new emanations succeeding them out of the said compressed body.

Now this which we have declared by the example of cold, compressing a particular body, hapneth in all bodies whersoever they be in the world: for this being the unavoydable effect of heat and of cold, whersoever they reside; (which are the active qualities, by whose means not onely fire and water and the other two Elements; but all other mixed bodies composed of the Elements, have their activity) and they being in all bodies whatsoever (as we have proved above) it followeth evidently, that there is not a body in the world, but hath about it self an orbe of emanations of the same nature which that body is of. Within the compasse of which orbe, when any other body cometh that receiveth an immutation by the little atomes whereof that orbe is composed, the advenient body seemeth to be affected and as it were repleniſhed with the qualities of the body from whence they issue. Which is then said to work upon the body that imbibeth the emanations that flow from it. And because this orbe (regularly speaking) is in the form of a sphere, the passive body is said to be within the sphere of the others activity.

2. The reason why no body can work in distance.

Secondly, when Philosophers pronounce: that *No corpore all nature can operari in distans*; that is, that no body can work upon another remote from it, without working first upon the body that lieth between them, which must continue and piece up the operation from the agent to the patient. The reason and truth of this maxime is in our Philosophy evident; for we having shewed

shewed that action among bodies is performed for the most part by the emission of little parts out of one body into another: as also, that such little parts cannot stream from the body that is their fountain, and settle upon a remote body, without passing through the interjacent bodies; which must furnish them, as it were, with channels and pipes to convey them whither they are to go; It followeth manifestly, that the active emissaries of the working body, can never reach their distant mark, unless they be successively ferried over the medium, that lieth between them; in which, they must needs leave impressions of their having been there, and so work upon it in their passage, and leave in it their qualities and complexions; as a payment for their waftage over.

3. An objection answered against the manner of explicating the former axiome.

But peradventure some may contend, that these invisible serjeants and workmen are too feeble and impotent to perform those visible great effects we daily see. As when fire at the length burneth a board that hath been a great while opposed to it, though it touch not the body of the fire; or when a loadstone draweth unto it a great weight of iron that is distant from it.

Unto whom we shall reply, that if he will not grant these subtile emanations from the agent body, to be the immediate workers of these effects; he must allot that efficacy unto the whole corpulency of all the Agent working in bulk (for besides the whole, and the parts there is no third thing to be considered in bodies; since they are constituted by quantity;) but the whole cannot work otherwise then by locall motion: which in this case it cannot do, because by the supposition, it is determined to keep its distance from the passive body, and not to move towards it. Therefore, this is impossible; whereas the other can appear but difficult at the worst, and therefore must be admitted, when no better and more intelligible solution can be found.

But withall we must note that it is not our intention to say, but that it may in some circumstãces happen that some particular action or effect may be wrought in a remote part or body, wch shal not be the same in the intermediate body that lieth between the agent and the patient, & that conveyeth the agents working atomes to the others body. As for example when tinder or naphtha is by fire made to burn at a yard distance from it, when the interjacent aire is but warmed by that fire. Or when the sun, by means of a burning-glasse or of some other reflexion, setteth some

some bodies on fire, and yet onely enlighteneth the glasse and the aire that are in the way. The reason of which is manifest to be the divers dispositions of the different subjects in regard of the Agent: and therefore it is no wonder that divers effects should be produced according to those divers dispositions.

4. Of reaction and first in pure locall motion, that each Agent must suffer in acting and act in suffering.

A third position among Philosophers is, that all bodies which work upon others, do likewise as the same time, wherein they work; suffer from those they work upon: and contrariwise that all bodies which suffer from others, do at the same time work back again upon them. For the better understanding whereof, let us consider that all action among bodies is either purely locall motion, or else locall motion with certain particularities which give it a particular name. As when we expresse the locall motion of little atomes of fire, or of earth, or water upon and into other bodies by the words of heating or cooling; and so of the like. Now if the action be pure locall motion, and consequently the effect produced by that action be merely change of place; we must call to mind how two dense bodies moving one against the other, do each of them bear before them some little quantity of a rarer body immediately joyned unto them: and consequently, these more rare bodies must be the first to feel the power of the dense bodies and to receive impressions from their motions; each of them, by the opposite rare body, which like an huissier goeth before to make way for his following master that obligeth him to this service.

Now when these rare ushers have struggled a while like the first lightly-armed ranks of two armies in the interjacent field between their main battalies, that follow them close at the heels, they must at the length yield, when they are overborn by a greater weight then they can sustain; and then they recoile back, as it were to save themselves by getting in among the files of dense bodies that drove them on; which not opening to admit them, & yet they still flying violently from the mastering force that pursueth them; they presse so hard upon what at the first pressed them on, as notwithstanding their density and strength they force them to retire back: for unlesse they do so, they are not of the number of those that work upon one another.

And this retiring, is either on both sides, or but of one side. If both; then it is evident how each of them is an Agent, and each of

of them a sufferer; each of them overcoming his opposite in such sort, as himself likewise receiveth blows and losse. But if onely one of the dense bodies be so shocked as to recoile back, then that onely suffereth in its body, and the other suffereth onely in its virtue; that is, in the aire or other rare body it sendeth before it; which it driveth with such a violence, that it mastereth and quelleth the opposition of the other body, before it can reach to shake the dense body, before which it runneth. Yet that rare body must be pressed and broken into, in some measure, by the incounter of the other (which though never so weak yet maketh some resistance) but much more when it cometh to grapple with the dense body it self: and so between them, it is wounded and infeebled, like those souldiers that first enter a breach in a town, from whence when they have driven the enemy, they pursue him to the cittadell, and force him from thence too; and so how maimed soever they prove, they make a free & easie way without resistance for the whole body of their army to follow them, and take quiet possession of that which did cost them so much to win.

And thus we see how it may happen that one of these moving bodies doth not suffer so much as to be stayed in its journey; much lesse, to be driven back. And yet the other body at the same time work in some measure upon it, by working upon what is next to it; which recoiling against it must needs make some impression upon it, since there can be no opposition but must have some effect. Now this impression or effect, though it be not perceptible by causing a contrary motion, yet it must needs infeeble the virtue of the conquering Agent, & deaden the celerity of its motion. And thus it is evident, that in all pure locall motions of corporeall Agents, every one of them must in some proportion suffer in acting, and in suffering must act.

5. The former doctrine applyed to other locall motions designed by particular names. And that Suissehs argument is of no force against this way of doctrine.

And what we have said of this kind of action, may easily be applyed to the other where the effect of locall motion is designed by a particular name, as it is in the examples we gave of heating and cooling. And in that, the proceeding will appear to be the very same as in this; for if fire doth heat water, the water reacteth again, either upon the fire and cooleth it, if it be immediate unto it; or else upon the interjacent aire, if it be at a distance from the fire. And so the aire is in some measure cooled, by the cold atomes that issue from the water, whose compasse or sphere

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of activitity being lesser then the fires, they cannot cool so farre off, as the others can heat: but where they do arrive, they give their proportion of cold, in the very midst of the others army of fiery atomes, notwithstanding their multitude and violence.

According to which doctrine, our countryman Suisseth his argument, that in the schools is held insoluble, hath not so much as any semblance of the least difficulty: for it is evident that such atomes of fire and of water as we determine heat and cold to be, may passe and croud by one another into the subjects they are sent unto by divers little streams without hindering one another (as we have declared of aire and light) and each of them be received in their own nature and temper by the same subject; though sense can judge onely according to which of them is predominant, and according to the proportion of its superiority.

Upon which occasion we cannot chuse but note, how the doctrine of qualities is not onely unable to give account of the ordinary and plain effects of nature; but also useth to end in cleer impossibilities and contradictions if it be driven far: as this argument of Suisseth sheweth, and many others of the like nature.

6. Why some notions do admit of intension and remission; and others do not.

A fourth position among Philosophers is, that some notions do admit the denominations of Intension and Remission, but that others do not. The reason of which we shall clearly see, if we but consider how these termes of *intension and remission*, do but expresse *more or lesse*, of the thing that is said to be intended or remitted: for the nature of more and lesse doth imply a latitude and divisibility; and therefore cannot agree with the nature of such things as consist in an indivisible being. As for example to be a *whole* or to be an *equall*, cannot be sometimes more, sometimes lesse; for they consist in such a rigorous indivisible being, that if the least part imaginable be wanting it is no longer a *whole*, and if there be the least excesse between two things, they are no longer equall, but are in some other proportion then of equality in regard of one another.

And hence it is that Aristotle teacheth us that *substance* and the species of Quantity, do not admit of intension and remission; but that quality doth. For first in *substance*, we know that the signification of this word is, that w^ch maketh a thing be what it is, as is evident by our giving it for an answer to the question what a thing is. And therefore, if there were any divisibility

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of activitity being lesser then the fires, they cannot cool so farre off, as the others can heat: but where they do arrive, they give their proportion of cold, in the very midst of the others army of fiery atomes, notwithstanding their multitude and violence.

According to which doctrine, our countryman Suisseth his argument, that in the schools is held insoluble, hath not so much as any semblance of the least difficulty: for it is evident that such atomes of fire and of water as we determine heat and cold to be, may passe and croud by one another into the subjects they are sent unto by divers little streams without hindering one another (as we have declared of aire and light) and each of them be received in their own nature and temper by the same subject; though sense can judge onely according to which of them is predominant, and according to the proportion of its superiority.

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in substance, it would be in *what* the thing is; and consequently, every division following that divisibility, would make the thing another *what*, that is another thing. And so the substance that is pretended to be changed by intension or remission, would not be divided, as is supposed, but would cease to be, and another substance would succeed in the room of it. Whereby you see that every mutation in substance, maketh a new thing: and that more and lesse in quiddity cannot be pronounced of the same thing.

Likewise in quantity, it is clear that its Species do consist in an indivisible: for as in numbers, ten lions (for example) or ten Elephants are no more in regard of multitude then ten flees or ten motes in the sunne; and if you adde or take any thing from ten, it is no more ten, but some other number: so likewise in continued extension, a span, an ell, an ounce, or any other measure whatsoever, ceaseth to be a span and the rest, if you adde to it or diminish from it the least quantity imaginable. And peradventure, the same is also of figures, as of a sphere, a cube, a circle, a square, &c. though they be in the ranke of qualities.

But if we consider such qualities as heat, cold, moysture, drineſſe, softneſſe, hardneſſe, weight, lightneſſe, and the like; we shall find that they may be in any body sometimes more, sometimes lesse, (according as the excesse of any Element or mixture is greater in it, at one time then at another) and yet the body in which these qualities are intended or remitted, remain still with the same denomination. As when durt continueth still soft, though sometimes it be lesse soft, other whiles softer; and wax remaineth figurable, whether it be melted or congealed; and wood is still hot though it lose or gain some degree of heat.

But such intension in any subject whatsoever hath its determinate limits that it cannot passe; for when more of that quality that we say is intended (that is, more of the atomes of the active body) is brought into the body that suffereth the intension, then its complexion can brook; it resigneth its nature to their violence and becometh a new thing; such an one as they are pleased to make it. As when wood, with extremity of heating (that is, with bringing into it so many atomes of fire, that the fire is stronger in it then its own nature) is converted into fire, smoke, water, and ashes; and nothing remaineth of the nature of wood.

But before we end this chapter, we may remember how in the 7. That in every

part of our habitable world all the foure Elements, are found pure in small atomes; but not in any great bulk.

of the fourth we remitted a question concerning the existence of the Elements; (that is, whether in any places of the world there were any pure Elements, either in bulk or in little parts;) as being not ready to resolve it, till we had declared the manner of working of bodies one upon another. Here then will be a fit place to determine that, out of what we have discoursed concerning the actions, whereby bodies are made and corrupted: for considering the universal action of fire that runneth through all the bodies we have commerce withall, by reason of the suns influence into them and operation upon them with his light and beams which reacheth far and near; and looking upon the effects which we have shewed do follow thence: it is manifest, there cannot be any great quantity of any body whatsoever, in which fire is not intrinsecally mixed. And on the other side, we see that where fire is once mixed it is very hard to separate it totally from thence. Again, we see it is impossible that pure fire should be conserved, without being adjoyned to some other body; both because of its violent nativity, still streaming forth with a great impetuosity; as also because it is so easily overcome by any obsident body when it is dilated. And therefore we may safely conclude, that no simple Element can consist in any great quantity in this course of nature which we live in and take a survey of. Neither doth it appear to what purpose nature should have placed any such storehouses of simples, seeing she can make all needfull complexions by the dissolutions of mixed bodies into other mixed bodies savouring of the nature of the Elements, without needing their purity to begin upon.

But on the other side it is as evident that the Elements must remain pure in every compounded body in such extreme small parts as we use to call atomes: for if they did not, the variety of bodies would be nothing else, but so many degrees of rarity and density, or so many pure homogeneall Elements, and not bodies composed of heterogeneall parts: and consequently would not be able to shew that variety of parts which we see in bodies, nor could produce the complicated effects which proceed from them. And accordingly we are sure that the least parts which our senses can arrive to discover have many varieties in them: even so much that a whole living creature (whose organicall parts must needs be of exceeding different natures) may be so little, as into our

our eyes to ſeem indiviſible; we not diſtinguiſhing any difference of parts in it without the help of a multiplying glaſſe : as in the leaſt kind of mites, and in wormes picked out of childrens hands we dayly experience. So as it is evident that no ſenſible part can be unmingled. But then again, when we call to mind how we have ſhewed that the qualities which we find in bodies do reſult out of the compoſition, and mixtion of the Elements, we muſt needs conclude, that they muſt of neceſſity remain in their own eſſences in the mixed body. And ſo out of the whole diſcourſe, determine that they are not there in any viſible quantity, but in thoſe leaſt atomes, that are too ſubtile for our ſenſes to diſcern. Which poſition we do not underſtand ſo Metaphyſically as to ſay that their ſubſtantiall forms remain actually in the mixed body ; but onely that their accidentall qualities are found in the compound ; remitting that other queſtion unto Metaphyſicians (thoſe ſpirituall Anatomiſts) to decide.

## CHAP. XVII.

### *Of Rarefaction and Condenſation, the two firſt motions of particular bodies.*

OUr intenſion in this diſcourſe, concerning the natures and motions of bodies, aiming no further then at the diſcovery of what is or may be done by corporeall Agents; thereby to determine what is the work of immaterial & ſpirituall ſubſtances ; it cannot be expected at our hands that we ſhould deliver here an intire and complete body of naturall Philoſophy. But onely that we ſhould take ſo much of it in our way, as is needfull to carry us with truth and evidence to our journeyes end. It belongeth not then to us to meddle with thoſe ſublime contemplations which ſearch into the nature of the vaſt Univerſe, and that determine the unity and limitation of it ; and that ſhew by what ſtrings, and upon pinnes, and wheels, and hinges, the whole world moveth : and that from thence do aſcend unto an awfull acknowledgement and humble admiration of the primary cauſe ; from whence, and of which, both the being of it, and the beginning of the firſt motion, and the continuance of all others doth proceed and depend.

I. The Authours intent in this and the following chapters.

Nor indeed would it be to the purpoſe for any man to fail in

this Ocean, and to begin a new voyage of navigation upon it: unlesse he were assured, he had ballast enough in his ship to make her sink deep into the water and to carry her steddily through those unruly waves; and that he were furnished with skill & provision sufficient to go through, without either losing his course by steering after a wrong compasse, or being forced back again with short and obscure relations of discoveries: since others that went out before him, are returned with a large account to such as are able to understand and summe it up. Which surely our learned countreyman, and my best and most honoured friend, and to whom of all men living I am most obliged (for to him I owe that little which I know; and what I have, and shall set down in all this discourse, is but a few sparks kindled by me at his great fire) hath both profoundly, and acutely, and in every regard judiciously performed in his Dialogues of the world.

Mr. Thomas White.

Our task then (in a lower strain; and more proportionate to so weak shoulders) is to look no further then among those bodies we converse withall. Of which, having declared by what course and engines nature governeth their common motions, that are found even in the Elements, and from thence are derived to all bodies composed of them; we intend now to consider such motions as accompany divers particular bodies, and are much admired by whosoever understandeth not the causes of them.

2. That bodies may be rarified, both by outward and inward heat; and how this is performed.

To begin from the easiest and most connexed with the actions of the Elements, the handsell of our labour will light upon the motions of *Rarefaction and Condensation*, as they are the passions of mixed bodies. And first for Rarefaction; we may remember how it proceedeth originally from fire, and dependeth of heat; as is declared in the former chapter: and whersoever we find Rarefaction, we may be confident the body which suffereth it, is not without fire working upon it. From hence we may gather, that when the aire imprisoned in a baloon or bladder, swelleth against what containeth it; and stretcheth its case, and seeketh to break out; this effect must proceed from fire or heat (though we see not the fire) working either within the very bowels of the aire, or without, by pressing upon what containeth it, and so making it self a way unto it.

And that this latter way is able to work this effect, may be

be convinced by the contrary effect from a contrary cause: for take a bladder stretched out unto its greatest extent by aire shut up within it; and hang it in a cold place; and you will see it presently contract it self into a lesse roome; and the bladder will grow wrinckled and become too big for the aire within it. But for immediate proof of this position, we see that the addition of a very small degree of heat, rarifieth the aire in a weather-glasse, (the aire receiving the impression of heat, sooner then water) and so maketh it extend it self into a greater place; and consequently, it presseth upon the water; and forceth it down into a lesse roome then formerly it possessed. And likewise we see quicksilver and other liquors, if they be shut up in glasses close stopped and set in sufficient heat (and a little is sufficient for this effect) they will swell and fill their glasses; and at the last break them, rather then not find a way to give themselves more roome; which is then grown too straight in the glasse, by reason of the rarefaction of the liquors by the fire working upon them.

Now again; that this effect may be wrought by the inward heat, that is enclosed in the bowels of the substance thus shut up; both reason and experience do assure us: for, they teach us that if a body which is not extremely compacted, but that by its looseneſſe is easily divisible into little parts (such a one as wine, or other spirituall liquors) be inclosed in a vessell; the little atomes that perpetually move up and down in every space of the whole world, making their way through every body, will set on work the little parts, in the wine for example, to play their game: so that the hot and light parts (if they be many) not enduring to be compressed and kept in by the heavie and cold ones, do seek to break out with force: and till they can free themselves from the dense ones that would imprison them they carry them along with them, and make them to swell out as well as themselves.

Now if they be kept in by the vessell, so that they have not play enough; they drive the dense ones (like so many little hammers or wedges) against the sides of it, and at the length do break it, and so do make themselves way, to a larger roome. But if they have vent, the more fiery hot spirits fly away, & leave the other grosser parts quiet and at rest. On the other side if the hot and light parts in a liquor be not many nor very active, and the vessell be so full that the parts have not free scope to remove

and make way for one another, there will not follow any great effect in this kind: as we see in bottled beer or ale, that worketh little, unlesse there be some space left empty, in the bottle. And again; if the vessell be very much to big for the liquour in it, the fiery parts find room, first to swell up the heavy ones; and at the length to get out from them, though the vessel be close stopped; for they have scope enough to float up and down between the surface of the liquour, and the roof of the vessel.

And this is the reason that if a little beer or small wine be left long in a great cask, be it never so close stopped, it will in time grow dead. And then, if at the opening of the bung (after the cask hath been long unstirred) you hold a candle close to it, you shall at the instant see a flash of flame environing the vent. Which is no other thing, but the subtile spirits that parting from the beer or wine, have left it dead; and flying abroad as soon as they are permitted, are set on fire by the flame that they meet with in their journey, as being more combustible (because more subtile) then that spirit of wine which is kept in form of liquour: and yet that likewise (though much grosser) is set on fire by the torch of flame. And this happeneth not onely to wine, and beer, or ale, but even to water. As dayly experience sheweth in the east Indian ships, that having been 5 or 6 years at sea, when they open some of their casks of Thames water in their return homewards (for they keep that water till the last; as being their best and most durable; and that groweth lighter and purer, by the often putrifyings through violent motions in storms, every one of which maketh new grosse and earthy parts fall down to the bottome, and other volatile ones ascend to the top;) a flame is seen about their bungs if a candle be near, as we said before of wine.

And to proceed, with confirming this doctrine by further experience; we dayly see that the little parts of heat being agitated and brought into motion in any body; they enter and pierce into other parts, & incorporate themselves with them, and set them on fire if they be capable thereof: as we see in wet hay or flax laid together in great quantity. And if they be not capable of taking fire, then they carry them with them to the outside; & when they can transport them no further, part flies away, & other part flaies

with

with them: as we see in new beer or ale, & in must of wine; in wch a substance usually called the mother, is wrought up to the top.

Which in wine, will at the last be converted into Tartar; when the spirits that are very volatile, are flown away; and do leave those parts from whence they have evaporated, more grosse and earthy then the others, where the grosser and subtiler parts continue still mixed. But in beer or rather in ale; this mother, which in them we call barm, will continue longer in the same consistence, and with the same qualities; for the spirits of it are not so fiery that they must presently leave the body they have incorporated themselves withall; nor are hot enough to bake it into a hard consistence. And therefore bakers make use of it to raise their bread; which neither it will do, unlesse it be kept from cold; both which, are evident signes that it works in force of heat; and consequently, that it continueth still a hot & light substance.

And again we see that after wine or beer hath wrought once, a violent motion will make it work anew. As is dayly seen in great lightnings and in thunder, and by much rocking of them; for such motion ratifieth, and consequently heateth them: partly by separating the little parts of the liquour, which were before as glewed together, and therefore lay quietly; but now, by their pulling asunder, and by the liquours growing thereby more loose then it was, they have freedome to play up and down; and partly by beating one part against another; which breaketh and divideth them into lesser atomes, & so bringeth some of them into the state of fire; which you may remember, is nothing else but a body brought into such a degree of littlenesse and rarity of its parts.

And this is the reason why such hard and drie bodies as have an unctuous substance in them, are by motion either easily set on fire, or at the least, fire is easily gotten out of them. As happeneth in flints, and in divers other stones, which yield fire when they are strucken; and if presently after you smell unto them, you shall perceive an odour of brimstone and of burning which is a certain signe that the motion did convert into fire the naturall brimstone that was mingled with the flint, and whose denser parts were grown cold, and so stuck to the stone. And in like manner, the ivywood and divers others, as also the Indian canes (which from thence are called firecanes) being rubbed with some other stick of the same nature; if they be first very dry, will

of themselves set on fire: and the like will happen to coach-wheels in the summer if they be overheated with motion.

3. Of the great effects of Rarefaction.

To conclude our discourse of rarefaction, we may look a little into the power and efficacity of it, which is no where to be seen so clearly as in fire. And as fire is the generall cause of rarefaction, so is it of all bodies that which is most rarified. And therefore it is no marvail if its effects be the greatest that are in nature, seeing it is the proper operation of the most active Element. The wonderfull force of it we dayly see in thunder, in guns, in granado's, and in mines; of which, continuall experience, as well as severall histories witnesseth little lesse then miracles. Leaving them to the remarks of curious persons, we will onely look into the way by which so main effects do proceed from causes that appear so slender.

It is evident that fire (as we have said before) dilateth it self spherically; as nature sheweth us manifestly in bubbles of boyling water, and of milk, and generally of such substances as are of a viscuous composition; for those bubbles being round, do assure us that the cause which made them, did equally dilate them from the center unto all parts. Now then remembring the infinite multiplication which is in fire, we may conceive that when a grain of gun-powder is turned thereinto, there are so many little bubbles of a viscuous substance one backing another with great celerity, as there are parts of fire more then there were of gun-powder. And if we make a computation of the number and of the celerity of these bubbles, we shall find that although every one of them single do seem to be of an inconsiderable force, yet the whole number of them together, will exceed the resistance of the body moved or broken by them: especially, if we note, that when hard substances have not time allowed them to yield, they break the sooner. And then we shall not so much admire the extremities we see acted by these means.

4. The first manner of condensation, by heat.

Thus having looked into the nature of rarefaction, and traced the progresse of it from the motion of the sun & fire; in the next place we are to examine the nature of condensation. And we shall oftentimes find it likewise an effect of the same cause otherwise working; for there being two different wayes to dry any wet thing; the one, by taking away that juyce which maketh a body liquid; the other, by putting more drought to the wet bo-

dy.

dy, that it may imbibe the moisture; this latter way doth, as well as the former, condense a body: for by the close sticking of wet to dry, the most part of condensation is effected in compounded bodies.

The first of these wayes, doth properly and immediately proceed from heat; for heat entring into a body, incorporateth it self with the moist and viscuous parts it findeth there: as purging medicines do with the humours they work upon; which when the stomack can no longer entertain (by reason of their unruly motions in wrestling together) they are both ejected grappling with one another; and the place of their contention is thus, by the supervenience of a guest of a contrary nature (that will not stay long there) purged from the superabundance of the former ones that annoyed it. Even so, the fire that is greedily drunk up by the watry and viscuous parts of a compounded body; and whose activity and restlesse nature will not endure to be long imprisoned there, quickly pierceth quite through the body it entereth into, and after a while streameth out at the opposite side, as fast as it entered on the side next to it, and carrieth away with it those glewy parts it is incorporated with: and by their absence, leaveth the body they part from, dryer then at the first it was.

Which course we may observe in sirrups that are boyled to a consistence, and in broths that are consumed unto a jelly: over which, whiles they are making by the fire under them, you see a great steam; which is, the watry parts that being incorporated with fire, flie away in smoke. Likewise when the sea-water is condensed into salt, you see it is an effect of the sunne or fire that exhaleth or boyleth away all the palpable moisture. And so when wet clothes are hanged either in the sunne or at the fire, we see a smoke about the clothes, and heat within them; which being all drawn out from them, they become dry.

And this deserveth a particular note, that although they should be not quite dry, when you take them from the fire; yet by then they are cool, they will be dry: for the fire that is in them when they are removed from the main stock of fire, flying away carrieth with it the moisture that was incorporated with it: and therefore whiles they were hot, that is, whiles the fire was in them they must also be moist; because the fire and the moisture were grown

grown to be one body: & could not become through dry with that measure of fire, (for more would have dryed them, even whiles they were hot) untill they were also grown through cold. And in like manner, sirupes, hydromels, gellies, and the like grow much thicker after they are taken off from the fire, then they were upon the fire, and much of their humidity flieth away with the fire, in their cooling, whereby they lessen much of their quantity, even after the outward fire hath ceased from working upon them.

Now if the moist parts, that remain after the drying, be by the heat well incorporated in the dry parts; and so do occasion the dry parts to stick close together; then that body is condensed, and will (to the proportion of it) be heavier in a lesse bulk; as we see that metalls are heavier then stones.

5. The second manner of condensation by cold.

Although this effect be in these examples wrought by heat, yet generally speaking it is more proper to cold: which is the second way of drying a moist body. As when in Greenland, the extreme cold freezeth the whalefishers beer into ice, so that the stewards divide it with axes and wedges, and deliver their portions of drink to their ships company, and their shallopes gings, in their bare hands: but in the innermost part of the butte, they find some quantity of very strong liquour, not inferiour to moderate spirit of wine. At the first, before custome had made it familiar unto them, they wondered that every time they drew at the tap, when first it came from their ships to the shore (for the heat of the hold would not let it freese) no liquour would come, unlesse they new tapped it with a longer gimlet: but they thought that pains well recompenced, by finding it in the tast to grow stronger and stronger; till at the last, their longest gimlets would bring nothing out; & yet the vessell not a quarter drawn off; which obliged them then to stave the cask, that so they might make use of the substance that remained.

The reason of this, is evident: that cold seeking to condense the beer by mingling its dry and cold parts with it, those that would indure this mixture, were imbibed and shrunk up by them. But the other rare and hot parts that were squeesed out by the dense ones which entered to congeal the beer, and were forsed into the middle of the vessel (which was the furthest part for them to retire unto, from their invironing enemies) did conserve

serve themselves in their liquid form, in defiance of the assaulting cold; whiles their fellows, remaining by their departure more grosse and earthy then they were before, yielded to the conquerour, they could not shift away from, and so were dryed and condensed in ice: which when the mariners thawed, they found it like faire water, without any spirits in it or comforting heat to the stomack.

This manner of condensation, which we have described in the freesing of beer, is the way most practised by nature; I mean, for immediate condensation (for condensation is secondarily, wheresoever there is rarefaction which we have determined to be an effect of heat.) And the course of it is: that a multitude of earthy and dry bodies being driven against any liquor, they easily divide it, by means of their density, their dryness, and their littleness (all which in this case do accompany one another; and are by us determined to be powerfull dividers;) and when they are gotten into it, they partly suck into their own pores the wet and diffused parts of the liquide body; and partly they make them (when themselves are full) stick fast to their dry sides, and become as a glew to hold themselves strongly together. And thus they dry up the liquor; and by the naturall pressing of gravity they contract it into a lesser room. No otherwise then when we force much wind or water into a bottle; and by pressing it more and more, make it lye closer then of its own nature it would do. Or rather, as when ashes being mingled with water; both those substances do stick so close to one another, that they take up lesse room then they did each apart.

This is the method of frosts, and of snow, and of ice, both naturall and artificiall; for in naturall freesing, ordinarily the north or northeast wind by its force bringeth and driveth into ours liquours, such earthy bodies as it hath gathered from rocks covered with snow; which being mixed with the light vapours whereof the wind is made, do easily find way into the liquors, and then they dry them into that consistence which we call ice. Which in token of the wind it hath in it, swimmeth upon the water, and in the vessell where it is made, riseth higher then the water did whereof it is composed: and ordinarily it breaketh from the sides of the vessell, so giving way to more wind to come in, and freese deeper and thicker.

But

3. That yce is not water rarified but condenſed.

But becauſe Galileus, *Nel diſcorſo intorno alle coſe che ſtanno in ſu l' acqua, pag.* 4. was of opinion that yce was water rarified, and not condenſed; we muſt not paſſe over this verity, without maintaining it againſt the oppoſition of ſo powerfull an adverſary. His arguments are, firſt that yce taketh up more place then the water did of which it was made; which is againſt the nature of condenſation. Secondly, that quantity for quantity yce is lighter then water; whereas things that are more denſe are proportionally more heavy. And laſtly, that yce ſwimmeth in water, whereas we have often taught, that the more denſe deſcendeth in the more rare.

Now to reply to theſe arguments, we ſay firſt, that we would gladly know how he did to meaſure the quantity of the yce, with the quantity of the water of which it was made; and then when he hath ſhewed it, and ſhewed withall that yce holdeth more place then water; we muſt tell him that his experiment concludeth nothing againſt our doctrine, becauſe there is an addition of other bodies mingled with the water to make yce of it as we touched above; and therefore that compound may well take up a greater place then the water alone did, and yet be denſer then it; and the water alſo be denſer then it was.

And that other bodies do come into the water and are mingled with it, is evident out of the exceeding coldneſſe of aire, or ſome very cold wind; one of which two never miſſeth to reigne whenſoever the water freezeth: and both of them do argue great ſtore of little earthy dry bodies abounding in them, which ſweeping over all thoſe that lie in their way and courſe, muſt of neceſſity be mixed with ſuch as give them admittance; which water doth very eaſily. And accordingly we ſee that when in the freezing of water the yce groweth any thing deep, it either ſhrinketh about the borders, or at the leaſt lieth very looſe, ſo as we cannot doubt but that there is a free paſſage for more of ſuch ſubtile bodies to get ſtill to the water, and freez it deeper.

To his ſecond argument, we ask how he knoweth that yce quantity for quantity, is lighter then water? For although of a ſpunge that is full of water, it be eaſie to know what the ſpunge weigheth, and what the water that was ſoked into it, becauſe we can part the one of them from the other, and keep each apart to examine their weights, yet to the like between yce and water,

water, if yce be throughout full of aire (as of necessity it must be) we believe impossible. And therefore it may be lighter in the bulk then water, by reason of the great pores caused in it, through the shrinking up of the parts of water together (which pores must then necessarily be filled with aire) & yet every part by it self (in which no aire is) be heavier then so much water.

And by this it appeareth that his last argument (grounded upon the swimming of yce in water) hath no more force then if he would prove that an yron or an earthen dish, were lighter, & consequently more rare then water, because it swimmeth upon it; which is an effect of the aires being contained in the belly of it (as it is in yce) not a signe of the metalls being more rare then water.

Whereas on the contrary side, the proof is positive and clear for us; for it cannot be denied, but that the mingling of the water with other bodies more dense then it, must of necessity make the compound and also the water it self become more dense then it was alone. And accordingly we see, that yce half thawed (for then much of the aire is driven out, and the water beginneth to fill the pores wherein the aire resided before) sinketh to the bottom: as an iron dish with holes in it (whereby the water might get into it) would do. And besides, we see that water is more diaphanous then yce, and yce more consistent then water. Therefore I hope we shall be excused, if in this particular we be of a contrary opinion to this great personage.

7. How wind, snow, and hail are made; and wind by rain allayed.

But to return unto the thrid of our discourse. The same that passeth here before us, passeth also in the sky with snow, hail, rain, and wind. Which that we may the better understand, let us consider how winds are made: for they have a main influence into all the rest. When the sunne by some particular occurrent raiseth great multitudes of atomes from some one place, and they either by the attraction of the sun, or by some other occasion, do take their course a certain way; this motion of those atomes we call a wind: which according to the continuance of the matter from whence these atomes rise, endureth a longer or a shorter time, and goeth a farther or a shorter way; like a river, or rather like those eruptions of waters, which in the Northern parts of England they call *Gypsies:* the which do break out at uncertain times, and upon uncertain causes, and flow likewise with an

an uncertain duration. So these winds being composed of bodies in a determinate proportion heavier then the aire, do run their course from their height to the ground, where they are supported (as water is by the floore of its channell) whiles they perform their carreer; that is, untill they be wasted either by the drawing of the sun, or by their sticking & incorporating into grosser bodies

Some of these winds according to the complexion of the body out of which they are extracted, are dry; as those which come from barren mountains covered with snow: others are moist, as those that come out of marishy or watry places: others have other qualities; as of heat, or cold, of wholesomnesse, or unwholsomnesse, and the like; partly from the source, and partly from the bodies they are mingled with in their way.

Such then being the nature and origine of winds; if a cold one do meet in the aire with that moist body whereof otherwise rain would have been made, it changeth that moist body into snow or into hail; if a dry wind meet with a wet body it maketh it more dry, and so hindreth the rain that was likely to be: but if the wet body overcome the dry wind, it bringeth the wind down along with it; as we see when a shoure of rain allaieth a great wind.

And that all this is so, experience will in some particulars instruct us as well as reason, frō whence the rest may be evidently inferred. For we see that those who in imitation of nature would convert water into ice, do take snow or ice & mingle it with some active dry body, that may force the cold parts of the snow from it; & then they set the water (in some fit vessel) in the way that those little bodies are to take, which by that means entring into it, do strait incorporate themselves therewith, & of a sudden do convert it into ice. W^ch^ processe you may easily try, by mingling salt armoniake with the snow; but much more powerfully by setting the snow over the fire, whiles the glasse of water to be congealed stands in it after the manner of an egge in salt. And thus fire it self, though it be the enemy and destroyer of all cold, is made the instrument of freezing. And the same reason holdeth in the cooling of wine with snow or yce, when after it hath been a competent time in the snow, they whose charge it is, do use to give the vessel that containeth the wine, three or foure turns in the snow; so to mingle through the whole body of the wine, the

cold

cold received first but in the outward parts of it, and by pressing, to make that without have a more forcible ingression.

But the whole doctrine of Meteors is so amply, so ingeniously, and so exactly performed by that never enough praised Gentleman Monsieur Des Cartes in his Meteorologicall discourses; as I should wrong my self and my Reader, if I dwelled any longer upon this subject. And whose Physicall discourses, had they been divulged before I had entred upon this work, I am perswaded would have excused the greatest part of my pains in delivering the nature of bodies.

8. How parts of the same or divers bodies are joyned more strongly together by condensation.

It were a fault to passe from treating of condensation, without noting so ordinary an effect of it as is the joyning together of parts of the same body, or of divers bodies. In which we see for the most part that the solide bodies which are to be joyned together, are first either heated or moistened, that is, they are rarified: and then they are left to cold aire or to other cold bodies to thicken and condense (as above we mentioned of syrupes and jellies;) and so they are brought to stick firmly together. In the like manner we see that when two metalls are heated till they be almost brought to running, and then are pressed together by the hammer, they become one continued body. The like we see in glasse, the like in wax, and in divers other things. On the contrary side; when a broken stone is to be pieced together, the pieces of it must be wetted, and the ciment must be likewise moistened, and then joyning them aptly, and drying them, they stick fast together. Glew is moistened, that it may by drying afterwards hold pieces of wood together. And the spectacle-makers have a composition which must be both heated and moistened, to joyn unto handles of wood the glasses which they are to grind. And broken glasses are cimented with cheese and chalk or with garlick.

All these effects our sense evidently sheweth us, arise out of condensation; but to our reason it belongeth to examine particularly by what steps they are performed. First then we know that heat doth subtilize the little bodies which are in the pores of the heated body; and partly also it openeth the pores of the body it self, if it be of a nature that permitteth it; as it seemeth those bodies are, which by heat are mollified or are liquefactible. Again, we know that moisture is more subtile to enter into small creeks then

then dry bodies are; especially when it is pressed; for then it will be divided into very little parts, and will fill up every little chink; and nevertheless if it be of a grosse and viscuous nature, all the parts of it will stick together. Out of these two properties we have, that since every body hath a kind of orb of its own exhalations, or vapours round about it self (as is before declared,) the vapours which are about one of the bodies, will more strongly and solidly (that is, in more abundant & greater parts) enter into the pores of the other body against which it is pressed when they are opened and dilated: and thus they becoming common to both bodies, by flowing from the one, and streaming into the other, and sticking to them both will make them stick to one another. And then as they grow cold and dry, these little parts shrink on both sides; and by their shrinking draw the bodies together; and withall do leave greater pores by their being compressed together, then were there when by heat and moysture they were dilated; into which pores the circumstant cold parts do enter, and thereby do as it were wedge in the others; and consequently do make them hold firmly together the bodies which they joyn.

But if art or nature should apply to this juncture any liquour or vapour, which had the nature and power to insinuate it self more efficaciously to one of these bodies, then the glew which was between them did; of necessity in this case these bodies must fall in pieces. And so it happeneth in the separation of metalls by corrosive waters; as also in the precipitation of metalls or of salts when they are dissolved in such corrosive waters, by means of other metalls or salts of a different nature: in both which cases the entrance of a latter body that penetrateth more strongly, and uniteth it self to one of the joyned bodies but not to the other, teareth them asunder, and that which the piercing body rejecteth, falleth into little pieces; and if formerly it were joyned with the liquour, it is then precipitated down from it in a dust

9. Vacuities cannot be the reason why water impregnated to the full with one kind of salt, will notwithstanding receive more of another.

Out of which discourse we may resolve the question of that learned and ingenious man Petrus Gassendus; who by experience found, that water impregnated to fulnesse with ordinary salt, would yet receive a quantity of other salt; and when it would imbibe no more of that, would nevertheless take into it a proportion of a third; and so of severall kinds of salts one af-

ter another: which effect he attributed to vacuities or porous spaces of divers figures, that he conceived to be in the water; whereof some were fit for the figure of one salt, and some for the figure of another. Very ingeniously; yet if I misse not my mark most assuredly he hath misled his.

For first, how could he attribute divers sorts of vacuities to water without giving it divers figures? And this would be against his own discourse, by which every body should have one determinate naturall figure.

Secondly, I would ask him if he measured his water after every salting? and if he did, whether he did not find the quantity greater, then before that salt was dissolved in it? Which if he did (as without doubt he must) then he might safely conclude that his salts were not received in vacuities; but that the very substance of the water gave them place, and so encreased by the receiving of them.

Thirdly, seeing that in his doctrine every substance hath a particular figure; we must allow a strange multitude of different shapes of vacuities to be naturally in water; if we will have every different substance wherewith it may be impregnated (by making decoctions, extractions, solutions, and the like) to find a fit vacuity in the water to lodge it self in. What a difform net with a strange variety of mashes would this be? And indeed how extremely uncapable must it be of the quantity of every various kind of vacuity that you will find must be in it; if in every solution of one particular substance, you calculate the proportion between it and the water that dissolveth it, and then multiply it according to the number of severall kinds of substances that may be dissolved in water? By this proceeding, you will find the vacuities to exceed infinitely the whole body of the water; even so much that it could not afford subtile thrids enough to hold it self together.

Fourthly, if this doctrine were true it would never happen that one body or salt should precipitate down to the bottome of the water, by the solution of another in it, w^ch^ every Alchymist knoweth, never faileth in due circumstances: for seeing that the body which precipitateth, and the other which remaineth dissolved in the water, are of different figures, and therefore do require different vacuities, they might both of them have kept their pla-

ces in the water, without thrusting one another out of it.

Lastly, this doctrine giveth no account why one part of salt is separated from another by being put in the water, and why the parts are there kept so separated, which is the whole effect of that motion which we call dissolution.

10. The true reason of the former effect.

The true reason therefore of this effect, is (as I conceive) that one salt maketh the water apt to receive another; for the lighter salt being incorporated with the water, maketh the water more proper to stick unto an heavier, and by dividing the small parts of it to bear them up, that otherwise would have sunk in it. The truth and reason of which will appear more plain, if at every joynt we observe the particular steps of every salts solution. As soon as you put the first salt into the water, it falleth down presently to the bottome of it; and as the water doth by its humidity pierce by degrees the little joynts of this salt, so the small parts of it are by little and little separated from one another, and united to parts of water. And so infusing more and more salt, this progresse will continue, untill every part of water is incorporated with some part of salt: and then, the water can no longer work of it self but in conjunction to the salt with which it is united. After which, if more salt of the same kind be put into the water; that water so impregnated, will not be able to divide it; because it hath not any so subtile parts left, as are able to enter between the joynts of a salt so closely compacted: but may be compared to that salt, as a thing of equall drinesse with it; and therefore is unapt to moisten and to pierce it.

But if you put into this compound of salt and water, another kind of salt that is of a stronger and a drier nature then the former, & whose parts are more grossely united; then the first salt dissolved in the water, will be able to get in betwixt the joynts of the grosser salt, & will divide it into little parts; and will incorporate his already composed parts of salt and water into a decompound of two salts and water; untill all his parts be anew impregnated with the second grosser salt; as before, the pure water was with the first subtiler salt. And so it will proceed on, if proportionate bodies be joyned, untill the dissolving composition do grow into a thick body.

Unto which discourse we may adde, that when the water is so fully impregnated with the first salt, as it will receive no more,

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maining in the temper it is in; yet if it be heated, it will then afresh dissolve more of the same kind. Which sheweth, that the reason of its giving over to dissolve, is for want of having the water divided into parts little enough to stick unto more salt: which, as in this case the fire doth; so peradventure in the other, the acrimoniousnesse of the salt doth it.

11. The reason why bodies of the same nature do joyn more easily together then others.

And this is sufficient to give curious wits occasion by making further experiments, to search out the truth of this matter. Onely we may note what hapneth in most of the experiencies we have mentioned; to wit, that things of the same nature do joyn better and more eafily then others that are more estranged from one another. Which is very agreeable to reason; seeing that if nature do intend to have things consist long together, she must fit them for such consistence.

Which seemeth to proceed out of their agreement in foure qualities; first, in weight for bodies of divers degrees in weight, if they be at liberty, do seek divers places; and consequently substances of like weight, must of necessity find one another out, and croud together; as we have shewed, it is the nature of heat to make them do: now it is apparent that things of one nature, must in equall parts have the same or a near proportion of weight, seeing that in their composition, they must have the same proportion of Elements.

The second reason of the consistence of bodies together, that are of the same nature is, the agreement of their liquid parts, in the same degree of rarity and density: for as it is the nature of quantity in common to make all parts be one quantity; so it is the nature of the degrees of quantity, when two parts do meet that are of the same degree, to make them one in that degree of quantity; which is, to make them stick together in that degree of sticking, which the degree of density that is common to them both, maketh of its own nature. Whereas, parts of different densities, cannot have this reason of sticking: though, peradventure they may upon some other ground, have some more efficacious one. And in this manner, the like humid parts of two bodies, becoming one, the holes or receptacles in which those humide parts are contained must also needs be united.

The third reason is the agreeable proportion, which their severall figures have in respect of one another: for if any humidi-

ty be extracted out of a mixed body, especially, by the virtue of fire; it must have left pores of such figures, as the humidity that is drawn out of them, is apt to be cut into (for every humide body not being absolutely humide, but having certain dry parts mixed with it, is more apt for one kind of figure and greatnesse, then for another;) and by consequence, whensoever that humidity shall meet again with the body it was severed from; it will easily run through and into it all, and will fill exactly the cavities and pores it possessed before.

The last quality, in which bodies that are to consist long together, do agree, is the bignesse of the humide and dry parts of the same body: for if the humide parts be too big for the dry ones, it is clear that the dry ones must needs hang loosely together by them; because their glew is in too great a quantity. But if the humide parts be too little for the dry ones, then of necessity some portion of every little dry part must be unfurnisht of glew, by means whereof to stick unto his fellow; and so the sticking parts not being conveniently proportioned to one another, their adhesion cannot be so solid as if each of them were exactly fitted to his fellow.

## CHAP. XVIII.

### *Of another motion belonging to particular bodies, called Attraction; and of certain operations, termed Magicall.*

1. What Attraction is, and from whence it proceedeth.

HAving thus ended the two motions of rarefaction and of condensation; the next that offer themselves, are the local motions which some bodies have unto others. These are sometimes performed by a plain force in the body towards which the motion is: and other whiles by a hidden cause, which is not so easily discerned. The first, is chiefely that which is ordinarily said to be done by the force of nature to hinder *vacuum*, and is much practised by nature; as in drawing our breath, in sucking, and in many other naturall operations, which are imitated by art in making of pumpes, syphons, and such other instruments; and in that admirable experiment of taking up a heavy marble stone merely by another lying flat and smoothly upon it, without any other connexion of the two stones together; as also by that sport of boyes, when they spread a thin moistned leather upon a smooth broad stone, and presse it all over close to it, and then by pulling of a string fastned at the middle of the leather,

leather, they draw up likewise the heavy stone. In all which, the first cause of the motion proceedeth from that body towards wch the motion is made. And therefore is properly called *Attraction*.

For the better understanding and declaring of which, let us suppose two marble stones, very broad and exceeding smoothly polished to be laid one flat upon the other: and let there be a ring fastned at the back part of the uppermost stone; and exactly in the middle of it. Then by that ring, pull it up perpendicularly and steadily, and the undermost will follow sticking fast to the overmost; and though they were not very perfectly polished, yet the nethermost would follow for a while, if the ring be suddenly plucked up; but then it will soon fall down again. Now this plainly sheweth that the cause of their sticking so strongly together, when both the stones are very well polished, is for that nothing can well enter between them to part them; and so, it is reduced to the shortnesse of the aire that is betwixt them: which not being capable of so great an expansion, nor admitting to be divided thickwayes so much as is necessary to fill the first growing distance, between the two stones till new air findeth a course thither (that so, the swelling of the one, may hinder vacuity, till the other come into the rescue;) the two stones must needs stick together to certain limits; which limits will depend of the proportion that is between the weight, and the continuity of the nethermost stone.

2. The true sense of the Maxime, that *Nature abhorreth from vacuity*.

And when we have examined this, we shall understand in what sense it is meaned that *Nature abhorreth from Vacuity*, and what means she useth to avoid it. For, to put it as an enemy that nature fighteth against; or to discourse of effects that would follow from it, in case it were admitted, is a great mistake, and a lost labour; seeing it is nothing; and therefore can do nothing; but is merely a forme of expression to declare in short nothing else but that it is a contradiction, or implication in termes, and an impossibility in nature, for vacuity to have, or to be supposed to have a *Being*.

Thus then, since in our case, after we have cast all about, we can pitch upon nothing to be considered, but that the two stones do touch one another, and that they are weighty; we must apply our selves onely to reflect upon the effects proceeding from these two causes, their contiguity and their heavinesse; and we shall find

that as the one of them, namely the weight, hindereth the undermost from following the uppermost, so, contiguity obligeth it unto that course; and according as the one overcometh the other, so will this action be continued or interrupted.

Now that contiguity of substances do make one follow another, is evident by what our Masters in Metaphysicks teach us; when they shew that without this effect no motion at all could be made in the world, nor no reason could be given, for those motions we daily see. For since the nature of quantity is such, that whensoever there is nothing between two parts of it, they must needs touch and adhere and joyn to one another, (for how should they be kept asunder when there is nothing between them to part them?) if you pull one part away, either some new substance must come to be close unto that which removeth; or else the other which was formerly close to it, must still be close to it, and so follow it: for if nothing do come between, it is still close to it. Thus then, it being necessary that something must be joyned close to every thing; vacuity, (which is nothing) is excluded from having any being in nature.

And when we say that one body must follow another to avoid vacuity; the meaning is, that under the necessity of a contradiction they must follow one another, and that they cannot do otherwise. For it would be a contradiction to say that nothing were between two things and yet that they are not joyned close to one another. And therefore if you should say it, you would in other words say, they are close together, and they are not close together. In like manner, to say that vacuity is any where, is a pure contradiction; for vacuity being nothing hath no *Being* at all: and yet by those words it is said to be in such a place; so that they affirm it *to be* and *not to be*, at the same time.

3. The true reason of attraction.

But now let us examine if there be no means to avoid this contradiction and vacuity, other then by the adhesion, and following of one body upon the motion of another, that is closely joyned to it and every where contiguous. For sense is not easily quieted with such Metaphysicall contemplations, that seem to repugne against her dictaments; and therefore for her satisfaction we can do no lesse then give her leave to range about, and cast all waies in hope of finding some one that may better cõtent her: which when she findeth that she cãnot she will the lesse repine

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to yield her assent to the rigorous sequeles and proofs of reason.

In this difficulty then, after turning on every side, I for my part can discern no pretence of probabilitie, in any other means then in pulling down the lower stone by one corner; that so there may be a gaping between the two stones, to let in aire by little and little. And in this case you may say that by the intervention of aire, vacuity is hindered, and yet the lower stone is left at liberty to follow its own naturall inclination, and be governed by its weight. But indeed, if you consider the matter well, you will find that the doing this, requireth a much greater force, then to have the lower stone follow the upper: for it cannot gape in a straight line, to let in aire; since in that position, it must open at the bottom where the angle is made, at the same time that it openeth at the mouth: and then aire requiring time to passe from the edges to the bottome, it must in the mean while fall into the contradiction of vacuity. So that if it should open to let in aire; the stone, to compasse that effect, must bend, in such sort as wood doth when a wedge is put into it to cleave it.

Judge then what force it must be that should make hard marble of a great thicknesse bend like a wand; & whether it would not rather break and slide off, then do so: you will allow that a much lesse, will raise up the lower stone together with the uppermost. It must then of necessity fall out, that it will follow it, if it be moved perpendicularly upwards. And the like effect will be though it should be raised at oblique angles, so that the lowermost edge do rest all the way upon something that may hinder the inferiour stone from sliding aside from the uppermost.

4. Water may be brought by the force of attraction to what height soever.

And this is the very case of all those other experiments of art and nature, which we have mentioned above: for the reason holdeth as well in water and liquide things; as in solid bodies, untill the weight of the liquid body overcometh the continuity of it: for then, the thrid breaketh, and it will ascend no higher.

Which height, Galileo telleth us from the workmen in the Arsenall of Venice, is 40. foot; if the water be drawn up in a close pipe, in which the advantage of the sides helpeth the ascent. But others say that the invention is inlarged, and that water may be drawn to what height one pleaseth. Howsoever, the force which nature applieth to maintain the continuity of quantity, can have no limit, seeing it is grounded upon contradiction.

And therefore Galileo was much mistaken, when he thought to make an instrument whereby to discover the limits of this force.

We may then conclude, that the breaking of the water must depend from the strength of other causes. As for example, when the gravity is so great by increasing the bulk of the water, that it will either overcome the strength of the pipe, or else make the sucker of the pump rather yield way to aire, then draw up so great a weight: for which defects, if remedies be found, the art may surely be inlarged without end.

5. The doctrine touching the attraction of water in syphons.

This is particular in a syphon; that when, that arm of it which hãgeth out of the water is lower then the superficies of the water; then, it will run of it self; after it is once set on running by sucking. The reason whereof is, because the weight which is in the water pendant is greater then the weight of the ascending water; and thereby supplyeth the want of a continuall sucker. But if the nose of that arm that hangeth out of the water, be but even with the water; then the water will stand still in both pipes, or arms of the syphon, after they are filled with sucking. But if by the running out of the water, the outward pipe do grow shorter then to reach as low as the superficies of the water in the fountain from whence it runneth; in this case, the water in each arm of the syphon, will runne back into the fountain.

Withall, it is to be noted, that though the arm which is out of the water be never so long, yet if it reach not lower then the superficies of the fountain; the overquantity and weight of the water there, more then in the other arm, helpeth it nothing to make it runne out. Which is, because the declivity of the other arm overrecompenceth this overweight. Not that the weight in the shorter pipe hath so much force as the weight in the longer pipe: but because it hath more force then the greater weight doth exercise therein its running; for the greatest part of it force, tendeth another way then to the end of the pipe; to wit, perpendicularly towards the center. And so is hindered from effect, by the great sloping or little declivity of the pipe upon which it leaneth.

6. That the syphon doth not prove water to weigh in its own erbe.

But some considering how the vvater that is in the longer arm of the syphon is more in quantity then the vvater that is in the other arm of it vvhereat it runneth out, do admire vvhy the greater quantity of vvater doth not drayv back the lesse into the cistern,

ciſtern, but ſuffereth it ſelf to be lifted up, and drained away as if it run ſteeply downwards. And they imagine, that hence may be deduced, that the parts of water in the ciſtern do not weigh as long as they are within the orb of their own body.

Unto whō we anſwer; that they ſhould conſider how that to have the greater quantity of water, which is in the longer arm of the ſyphon (which arm is immerſed in the water of the ciſtern) to draw back into the ciſtern the water which is in the other arm of the ſyphon that hangeth out in the aire; it muſt, both raiſe as much of the water of the ciſtern as its own bulk is, above the levell which at preſent the whole bulk of water hath; and withall it muſt at the ſame time pull up the water which is in the other arm. Now it is manifeſt, that theſe two quantities of water together, are heavier then the water in the ſunk arm of the ſyphon; ſince one of them ſingle, is equall unto it. And by conſequence, the more water in the ſunk arm cannot weigh back the leſſe water in the hanging arm; ſince that, to do that, it muſt at the ſame time weigh up over and above, as much more in the ciſtern as it ſelf weigheth.

But turning the argument; I ſay, that if once the arm of the ſyphon that is in the aire, be ſuppoſed to draw any water, be it never ſo little, out of the ciſtern (whether occaſioned by ſucking or by whatſoever other means) it followeth that as much water as is drawn up, above the levell of the whole bulk in the ciſtern, muſt needs preſſe into the ſuncken arm from the next adjacent parts, (that is, from the bottom) to ſupply its emptying; and as much muſt of it ſelf preſſe down from above (according to its naturall courſe, when nothing violenteth it) to reſt in the place, that the aſcending water (which is lower then it) leaveth at liberty for it to take poſſeſſion of. And then it cannot be doubted; but that, this deſcending water, having all its weight in preſſing down applied to drive up the riſing water in the ſunk arm of the ſyphon; & the water in the other arm of the ſyphon without, having all its weight in rūning out applied at the ſame time to draw up the ſame water in the ſunk arm; this ſingle reſiſtant muſt yield to their double & maſtering force. And cōſequently, the water in the arm of the ſyphō that is in the aire, muſt needs draw the water that is in the other immerſed arm as long as the end of its pipe reacheth lower then the levell of the water in the ciſtern; for ſo long

long it appeareth by what we have said, it must needs be more weighty; since part of the rising water in the sunk arm of the syphon, is counterpoised by as much descending water in the cistern

And thus it is evident, that out of this experiment it cannot be inferred that parts of water do not weigh within the orb of their own whole: but onely, that two equall parts of water in their own orb (namely that which riseth in the sunken arm, & that which presseth down from the whole bulk in the cistern) are of equall weight and do ballance one another. So that never so little oddes between the two counterpoysing parcels of water which are in the aire must needs make the water run out at that end of the syphon, where the overweight of water is.

7. Concerning attraction caused by fire.

The attraction whose cause next to this is most manifest, is that which is made by the force of heat or of fire; for we see that fire ever draweth aire unto it; so notably, that if in a close room there be a good fire, a man that standeth at the door or at the window (especially without) shall hear such a noise that he will think there is a great wind within the chamber. The reason of this attraction is, that fire rarifying the aire which is next unto it; and withall spending it self perpetually, causeth the aire, and his own body mingled together, to flie up through the chimney or by some other passage. Whence it followeth of necessity that the next body must succeed into the place of the body that is flown away. This next body generally is aire, whose mobility and fluidity beyond all other bodies, maketh it of all others the fittest to be drawn; and the more of it that is drawn the more must needs follow. Now if there be floting in this aire any other atomes subject to the current which the aire taketh; they must also come with it to the fire, and by it, must be rarified, and be exported out of that little orb.

Hence it is, that men (with very good reason) do hold that fire aireth a chamber, as we terme it, that is, purifieth it, both because it purifieth it as wind doth by drawing a current of aire into it that sweepeth through it, or by making it purifie it self by motion, as a stream of water doth by running; as also, because those vapours which approach the fire, are burned and dissolved. So that the aire being noisome and unwholesome by reason of its grosseness, proceeding from its standing unmoved (like a stagnation of dead water, in a marish place) the fire taketh away that cause of annoyance.

By

8. Concerning attraction made by virtue of hot bodies, amulets &c.

By this very rule we learn that other hot things, which participate the nature of fire, must likewise( in other respects)have a resemblance in this quality. And accordingly we see that hot loafs in a bakers shop newly drawn out of the oven, are accounted to draw unto them any infection which is in the aire. The like we say of onyons,& other strong breathing substances; which by their smell shew much heat in them. In like manner it is conceived that pigeons,and rabets,and cats easily take infection, by reason of their extraordinary warmth which they have in themselves.

And this is confirmed by the practise of Physitians,who use to lay warm pigeons newly killed to the feet,wrists,or heads of sick persons;& young puppies to their stomacks,& sometimes certain hot gums to their navels; to draw out such vapours or humours as infest the body: for the same reason they hang amulets of arsenick, sublimate, dryed toads or spiders, about their patients necks, to draw unto them venimous qualities from their bodies. Hence also it is, that if a man be strucken by a viper or a scorpion, they use to break the body of the beast it self that stung him ( if they can get it)upon the wound: but if that beast be crawled out of their finding, they do the like by some other venimous creature; as I have seen a bruised toad laid to the biting of a viper. And they manifestly perceive the applyed body, to swell with the poyson sucked out from the wound, and the patient to be relieved and have lesse poyson; in the same manner as by cupping-glasses, the poyson is likewise drawn out from the wound: so that you may see,the reason of both, is the very same; or at the least very like one another. Onely,we are to note, that the proper body of the beast out of which the venome was driven into the wound,is more efficacious then any other to suck it out.

And the like is to be observed in all other kinds,that such vapours as are to be drawn, do come better and incorporate faster in bodies of like nature, then in those which have onely the common conditions of heat and dryness; the one of which serveth to attract;the other to fasten and incorporate into it self the moisture which the first draweth unto it. So we see that water soketh into a dry body, whence it was extracted, almost inseparably,& is hidden in it;as when it raineth first after hot weather, the ground is presently dried after the showre. Likewise we see that

that in most ciments, you must mingle a dust of the nature of the things wch are to be cimented, if you wil have them bind strongly

9. The naturall reason given for divers operations, esteemed by some to be magicall.

Out of this discourse, we may yield a reason for those magicall operations, which some attribute to the Devils assistance; peradventure becaus mans wickednesse hath been more ingenious then his good will; and so hath found more means to hurt then to help; nay when he hath arrived some way to help, those very helps have undergone the same calumny; because of the likenesse which their operations have to the others. Without doubt very unjustly, if there be truth in the effects. For where have we any such good suggestions of the enemy of mãkind proposed unto us, that we may with reason believe he would duly, settledly, and constantly concurre to the help and service of all those he so much hateth, as he needs do if he be the Authour of such effects? Or is not a wrong to Almighty God, and to his carefull instruments; rather to impute unto the Devil the aids which to some may seem supernaturall, then unto them of whom we may justly believe & expect such good offices and assistances? I mean, those operations, both good and bad, which ordinarily are called *Magneticall*, though peradventure wrongfully, as not having that property which denominateth the loadstone.

One thing I may assure, that if the reports be true, they have the perfect imitation of nature in them. As for example; that the weapons salve, or the sympathetick powder doth require in the using it, to be conserved in an equall and moderate temper: and that the weapon which made the wound, or the cloth upon which the bloud remaineth that issued from it, be orderly and frequently dressed; or else the wounded person will not be cured: likewise the steam or spirits, which at the giving of the wound did enter into the pores of the weapon, must not be driven out of it, (which will be done by fire; and so when it is heated by holding over coals, you may see a moisture sweat out of the blade at the opposite side to the fire, as farre as it entred into the wounded persons body; which being once all sweated out, you shall see no more the like steam upon the sword) neither must the bloud be washed out of the bloudy cloth; for in these cases, the powder, or salve, will work nothing. Likewise, if there be any excesse either of heat or of cold in keeping the medicated weapon or cloth; the patient feeleth that, as he would do, if the like

excesse

excesse were in any remedy that were applied to the wound it self: likewise if the medicated weapon or bloudy cloth, be kept too close, no effect followeth: likewise, the natures of the things used in these cures are of themselves soveraigne for healing the like griefs, though peradventure too violent if they were applyed in body without much attenuation.

And truly if we will deny all effects of this kind, we must in a manner renounce all humane faith: men of all sorts and qualities (and many of them such in my own knowledge, as I cannot question their prudence in observing, or their sincerity in relating) having very frequently made experience of such medicines, and all affirming after one fashion to have found the same effects. Adde to these, the multitude of other like effects, appearing or conceited to appear in other things. In some countries it is a familiar disease with kine to have a swelling in the soles of their feet: and the ordinary cure is, to cut a turf upon which they have troden with their sore foot, and to hang it upon a hedge; and as that dryeth away, so will their sore amend. In other parts they observe, that if milk newly come from the cow, do in the boyling runne over into the fire; and that this do happen often, and near together to the same cows milk; that cow will have her udder sore and inflamed: and the prevention is to cast salt immediately into the fire upon the milk. The herb *Persicaria* if it be well rubbed upon warts, and then be laid in some fit place to putrifie, causeth the warts to wear away as it rotteth: some say the like of fresh beef. Many examples also there are of hurting living creatures by the like means; which I set not down for fear of doing more harm by the evil inclination of some persons into whose hands they may fall; then profit by their knowing them, unto whom I intend this work.

But to make these operations of nature not incredible; let us remember how we have determined that every body whatsoever doth yield some steam, or vent a kind of vapour from it self; and consider, how they must needs do so most of all, that are hot and moist, as bloud and milk are, and as all wounds and sores generally are. We see that the foot of a hare or deer leaveth such an impression where the beast hath passed, as a dog can discern it a long time after: and a fox breatheth out so strong a vapour, that the hunters themselves can wind it a great way off, and

and a good while after he is parted from the place. Now joyning this, to the experiences we have already allowed of, concerning the attraction of heat; we may conclude that if any of these vapours do light upon a solid warm body, which hath the nature of a source unto them, they will naturally congregate and incorporate there; and if those vapours be joyned with any medicative quality or body, they will apply that medicament better then any chirurgeon can apply it. Then, if the steam of bloud and spirits, do carry with it from the weapon or cloth, the balsamike qualities of the salve or powder, and with them do settle upon the wound; what can follow but a bettering in it? Likewise, if the steam of the corruption that is upon the clod, do carry the drying quality of the wind which sweepeth over it when it hangeth high in the aire, unto the sore part of the cows foot; why is it not possible that it should dry the corruption there, as well as it dryeth it upon the hedge? And if the steam of burned milk can hurt by carrying fire to the dugge; why should not salt cast upon it, be a preservative against it? Or rather, why should not salt hinder the fire from being carried thither? Since the nature of salt, alwayes hindereth and suppresseth the activity of fire: as we see by experience when we throw salt into the fire below, to hinder the flaming of soot in the top of a chimney: which presently ceaseth, when new fire from beneath doth not continue it. And thus we might proceed in sundry other effects, to declare the reason and the possibility of them; were we certain of the truth of them: therefore we remit this whole question, to the autority of the testimonies.

## CHAP. XIX.

### *Of three other motions belonging to particular bodies, Filtration, Restitution, and Electricall attraction.*

1. What is Filtration; and how it is effected.

After these, let us cast our eye upon another motion, very familiar among Alchymists; which they call Filtration. It is effected by putting one end of a tongue, or labell of flannen, or of cotton, or of flax, into a vessel of water, and letting the other end hang over the brim of it. And it will by little and little draw all the water out of that vessel (so that the end which hangeth out be lower then the superficies of the water) and will make it all come over into any lower vessel you will reserve it in.

The

The end of this operation is, when any water is mingled with grosse and muddy parts (not dissolved in the water) to separate the pure and light ones from the impure. By which we are taught that the lighter parts of the water, are those which most easily do catch. And if we will examine in particular, how it is likely this businesse passeth; we may conceive that the body or linguet by which the water ascendeth, being a dry one, some lighter parts of the water, whose chance it is to be near the climbing body of flaxe, do begin to stick fast unto it: and then, they require nothing near so great force, nor so much pressing, to make them climbe up along the flaxe, as they would do to make them mount in the pure aire. As you may see, if you hold a stick in running water, shelving against the stream: the water will run up along the stick, much higher then it could be forced up in the open aire without any support, though the agent were much stronger then the current of the stream. And a ball will upon a rebound, run much higher upon a shelving board, then it would if nothing touched it. And I have been told that if an egsshell filled with dew be set at the foot of a hollow stick, the sun will draw it to the top of the shelving stick, whereas without a prop, it will not stirre it.

With much more reason then, we may conceive that water finding as it were little steps in the cotton to facilitate its journey upwards, must ascend more easily then those other things do; so as it once receive any impulse to drive it upwards: for the gravity both of that water which is upon the cotton, as also, of so many of the confining parts of water as can reach the cotton; is exceedingly allayed, either by sticking unto the cotton, and so weighing in one bulk with that dry body; or else, by not tending down straight to the center, but resting as it were upon a steep plain (according to what we said of the arme of a syphon that hangeth very sloping out of the water, and therefore draweth not after it a lesse proportion of water in the other arme that is more in a direct line to the center:) by which means the water as soon as it beginneth to climbe, cometh to stand in a kind of cone; neither breaking from the water below, (its bulk being big enough to reach unto it) nor yet falling down unto it.

2. What causeth the water in filtration to ascend.

But our chief labour must be, to find a cause that may make the water begin to ascend. To which purpose, consider how water of

of its own nature, compresseth it self together, to exclude any other body lighter then it is. Now in respect of the whole masse of the water, those parts which stick to the cotton, are to be accounted much lighter then water; not, because in their own nature they are so; but for the circumstances which accompany them, and do give them a greater disposition to receive a motion upwards then much lighter bodies, whiles they are destitute of such helps. Wherefore as the bulk of water weighing and striving downwards; it followeth that if there were any air mingled with it, it would to possesse a lesser place, drive out the aire: so here in this case, the water that is at the foot of the ladder of cotton, ready to climbe with a very small impulse, may be after some sort compared (in respect of the water) to aire by reason of the lightnesse of it: and consequently is forced up by the compressing of the rest of the water round about it. Which no faster getteth up, but other parts at the foot of the ladder do follow the first, and drive them still upwards along the tow; and new ones drive the second, and others the third, and so forth. So that with ease they climbe up to the top of the filter, still driving one another forwards, as you may do a fine towell through a musket barrell: which though it be too limber to be thrust straight through; yet cramming still new parts into it at the length you will drive the first quite through.

And thus, when these parts of water are got up to the top of the vessell on which the filter hangeth, and over it on the other side by sticking still to the tow, and by their naturall gravity, against which nothing presseth on this side the labell; they fall down again by little and little, and by drops break again into water in the vessell set to receive them.

3. Why the filter will not drop unlesse the labell hang lower then the water.

But now if you ask, why it will not drop unlesse the end of the labell that hangeth, be lower then the water. I conceive it is because the water which is all along upon the flannen, is one continued body hanging together, as it were a thrid of wire; and is subject to like accidents as such a continued body is. Now suppose you lay a wire upon the edge of the basin, which the filter resteth upon; and so make that edge the center to ballance it upon; if the end that is outermost be heaviest, it will weigh down the other; otherwise, not. So fareth it with this thrid of water: if the end of it that hangeth out of the pot, that is to be filtred

filtred be longer, and consequently heavier, then that which riseth; it must needs raise the other upwards, and fall it self downwards. Now the raising of the other, implieth lifting more water from the cistern, and the sliding of it self further downwards, is the cause of its converting into drops. So that the water in the cistern serveth like the flax upon a distaffe, and is spun into a thrid of water, still as it cometh to the flannen by the drawing it up, occasioned by the overweight of the thrid on the other side of the center.

Which to expresse better by a similitude in a solide body: I remember I have oftentimes seen in a Mercers shop, a great heap of massy gold lace lie upon their stall; and a little way above it a round smooth pin of wood, over which they use to hale their lace when they wind it into bottomes. Now over this pin, I have put one end of the lace; and as long as it hung no lower then the board upon which the rest of the lace did lie, it stirred not; for as the weight of the loose end carried it one way, so the weight of the other side where the whole was, drew it the other way, and in this manner kept it in equilibrity. But as soon as I drew on the hanging end to be heavier then the climbing side (for no more weigheth then is in the aire, that which lieth upon the board, having another center) then it began to roule to the ground: and still drew up new parts of that which lay upon the board, untill all was tumbled down upon the floore. In the same mander it hapneth to the water; in which, the thrid of it upon the filter is to be compared fitly unto that part of the lace which hung upon the pin; and the whole quantity in the cistern, is like the bulk of lace upon the shopboard; for as fast as the filter draweth it up, it is converted into a thrid like that which is already upon the filter: in like manner as the wheel converteth the flax into yarn, as fast as it draweth it out from the distaffe.

4. Of the motion of Restitution: and why some bodies stand bent, others not

Our next consideration will very aptly fall upon the motion of those things, which being bent, do leap with violence to their former figure: whereas others return but a little; and others do stand in that ply, wherein the bending of them hath set them. For finding the reason of which effects, our first reflexion may be to note, that a superficies which is more long then broad, containeth a lesse floore then that whose sides are equall, or nearer being equal: and that of those surfaces whose lines and angles are

all equall, that which hath most sides and angles, containeth still the greater floore. Whence it is that Mathematicians conclude a circle to be the most capacious of all figures: and what they say of lines in respect of a superficies; the same with proportion they say of surfaces in respect of the body contained. And accordingly we see by consequence, that in the making a bag of a long napkin, if the napkin be sewed together longwise, it holdeth a great deal lesse then if it be sewed together broadwise.

By this we see plainly, that if any body which is in a thick and short figure, be forced into a thinner (which by becoming thinner, must likewise become either longer or broader; for what it loseth one way it must get another) then that superficies must needs be stretched; which in our case, is a Physicall outside, or materiall part of a solid body, not a Mathematicall consideration of an indivisible Entity. We see also that this change of figures happeneth in the bending of all those bodies, whereof we are now enquiring the reason why some of them restore themselves to their originall figures, and others stand as they are bent.

Then to begin with the latter sort, we find that they are of a moist nature; as among metalls, lead, and tinne; and among other bodies, those which we account soft. And we may determine that this effect proceedeth, partly from the humidity of the body that standeth bent; and partly from a drinesse peculiar to it that comprehendeth and fixeth the humidity of it. For by the first, they are rendered capable of being driven into any figure, which nature or art desireth: and by the second, they are preserved from having their gravity put them out of what figure they have once received.

But because these two conditions are common to all solid bodies, we may conclude, that if no other circumstance concurred the effect arising out of them would likewise be common to all such: and therefore, where we find it otherwise, we must seek further for a cause of that transgression. As for example, if you bend the bodies of young trees, or the branches of others, they will return to their due figure. It is true, they will sometimes lean towards that way they have been bent: as may be seen even in great trees after violent tempests; and generally the heads of trees, and the ears of corn, and the grown hedgerowes will all bend one way in some countries, where some one wind hath a main

main predominance and reigneth most continually, as near the seashore upon the western coast of England (where the southwest wind bloweth constantly the greatest part of the yeare) may be observed: but this effect proceeding from a particular and extraordinary cause, concerneth not our matter in hand.

We are to examine the reason of the motion of Restitution, which we generally see in young trees, and branches of others, as we said before. In such, we see that the earthy part which maketh them stiffe (or rather stark) aboundeth more in them then in the others that stand as they are bent: at the least in proportion to their natures; but I conceive this is not the cause of the effect we enquire about; but that it is a subtile spirit which hath a great proportion of fire in it. For as in rarefaction, we found that fire, which was either within or without the body to be rarifyed, did cause the rarefaction, either by entering into it, or by working within it: so seeing here the question is, for a body to go out of a lesser superficies into a greater (which is the progresse of rarefaction; and hapneth in the motion of restitution;) the work must needs be done by the force of heat. And because this effect proceedeth evidently, out of the nature of the thing in which it is wrought, and not from any outward cause, we may conclude it hath its origine from a heat that is within the thing it self, or else that was in it, and may be pressed to the outward parts of it, and would sink into it again.

As for example, when a young tree is bended; both every mans conceit is, and the nature of the thing maketh us believe, that the force which bringeth the tree back again to its figure, cometh from the inner side that is bent; which is compressed together, as being shrunk into a circular figure from a straight one: for when solide bodies that were plain on both sides, are bent so as on each side to make a portion of a circle, the convex superficies will be longer then it was before, when it was plain, but the concave will be shorter. And therefore we may conceive that the spirits which are in the contracted part, (being there squeezed into lesse room, then their nature well brooketh) do work themselves into a greater space; or else that the spirits which are crushed out of the convex side by the extension of it, but do remain besieging it, and do strive to get in again, (in such manner as we have declared when we spoke of attraction, wherein we shewed

how the emitted spirits of any body will move to their own source, and settle again in it, if they be within a convenient compasse; ) and accordingly do bring back the extended parts to their former situation; or rather, that both these causes do in their kinds concurre to drive the tree into its naturall figure.

5. Why some bodies return onely in part to their naturall figure; others entirely.

But as we see when a stick is broken, it is very hard to replace all the splinters, every one in its proper situation; so it must of necessity fall out in this bending, that certain insensible parts both inward and outward are thereby displaced, and can hardly be perfectly rejoynted. Whence it followeth that as you see the splinters of a half broken stick, meeting with one another do hold the stick somewhat crooked; so these invisible parts do the like in such bodies as after bending stand a little that way. But because they are very little ones, the tree or the branch that hath been never so much bended, may (so nothing be broken in it) be set straight again by pains, without any notable detriment of its strength. And thus you see the reason of some bodies returning in part to their naturall figure, after the force leaveth them that did bend them.

Out of which you may proceed to those bodies that restore themselves entirely: whereof steel is the most eminent. And of it, we know that there is a fiery spirit in it, which may be extracted out of it, not onely by the long operations of calcining, digesting and distilling it; but even by grosse heating it, and then extinguishing it in wine and other convenient liquors, as Physicians use to do. Which is also confirmed by the burning of steel-dust in the flame of a candle, before it hath been thus wrought upon, which afterwards it will not do: whereby we are taught that originally there are store of spirits in steel, till they are sucked out. Being then assured, that in steel there is such abundance of spirits; and knowing that it is the nature of spirits to give a quick motion; and seeing that duller spirits in trees do make this motion of Restitution; we need seek no further, what it is that doth it in steel, or in any other things that have the like nature: wch through the multitude of spirits that abound in them (especially steel) do return back with so strong a jerk, that their whole body wil trēble a great while after, by the force of its own motiō

6. Concerning the nature of

By what is said, the nature of those bodies which do shrink and stretch, may easily be understood: for they are generally composed

posed of stringy parts, unto which, if humidity happen to arrive, they grow thereby thicker and shorter. As we see that drops of water getting into a new rope of a well, or into a new cable, will swell it much thicker, and by consequence make it shorter. Galileus noteth such wetting to be of so great efficacy, that it will shrink a new cable, and shorten it notably; notwithstanding the violence of a tempest, and the weight and jerks of a loden ship, do strain it what is possible for them to stretch it. Of this nature leather seemeth to be, and parchment, and divers other things, which if they be proportionably moystened, (and no exteriour force be applyed to extend them) will shrink up; but if they be overwetted, they will become flaccide. Again, if they be suddenly dried, they will shrivell up; but if they be fairly dried after moderate wetting, they will extend themselves again to their first length.

those bodies which do shrink and stretch.

7.

The way having been opened by what we have discourſed before we came to the motion of Restitution, towards the discovery of the māner how heavy bodies may be forced upwards contrary to their naturall motion, by very small means in outward appearance; let us now examine (upon the same grounds) if like motions to this of water, may not be done in some other bodies in a subtiler manner. In which, more or lesse needeth not trouble us; since we know, that neither quantity nor the operations of it do consist in an indivisible, or are limited to determined periods they may not passe. It is enough for us to find a ground for the possibility of the operation: and then the perfecting of it and the reducing of it to such a height as at the first might seem impossible and incredible, we may leave to the oeconomy of wise nature. He that learneth to reade, write, or to play on the lute, is in the beginning ready to lose heart at every step; when he considereth with what labour, difficulty, and slowneſse he joyneth the letters, spelleth syllables, formeth characters, fitteth and breaketh his fingers (as though they were upon the rack) to stop the right frets, and to touch the right strings. And yet you see how strange a dexterity is gained in all these by industry and practise; and a readineſse beyond what we could imagine possible, if we saw not daily the effects.

How great and wonderfull effects proceed from small, plain, and simple principles.

If then we can but arrive to decipher the first characters of the hidden alphabet we are now taking in hand, & can but spellingly

lingly read the first syllables of it; we need not doubt, but that the wise Authour of nature in the masterpiece of the creature (which was to expresse the excellency of the workman) would with excellent cunning and art dispose all circumstances so aptly, as to speak readily a complete language rising from those Elements; and that should have as large an extent in practise and expression, beyond those first principles, which we like children onely lisp out; as the vast discourses of wisest and most learned men are beyond the spellings of infants: and yet those discourses spring from the same root, as the others spellings do, and are but a raising of them to a greater height; as the admired musick of the best player of a lute or harp, that ever was, is derived from the harsh twangs of course bowstrings, which are composed together and refined, till at length they arrive to that wonderfull perfection. And so without scruple, we may in the businesse we are next falling upon, conclude that the admirable and almost miraculous effects we see, are but the elevating to a wonderfull height those very actions and motions which we shall produce as causes and principles of them.

8. Concerning Electricall attraction, and the causes of it.

Let us then suppose, that there is a solid hard body, of an unctuous nature; whose parts are so subtile and fiery, that with a little agitation they are much rarified, and do breath out in steams, (though they be too subtile for our eyes to discern) like unto the steam that issueth from sweating men or horses, or like the steam that flyeth from a candle when it is put out: but that these steams, as soon as they come into the cold aire, are by that cold suddenly condensed again; and by being condensed, do shorten themselves, and by little and little do retire, till they settle themselves upon the body from whence they sprung: in such manner as you may observe, the little tender horns of snails use to shrink back if any thing touch them, till they settle in little lumps upon their heads. If I say these strings of bituminous vapour should in their way outwards meet with any light & spungie body, they would pierce into it, and settle in it; and if it were of a competent bignesse for them to wield, they would carry it with them which way soever they go; so that if they shrink back again to the fountain frō whence they came, they must needs carry back with thē the light spungy body they have fixed their darts in

Consider then, that how much heat rarifieth, so much cold condenseth;

condenseth: and therefore such parts as by agitation were spun out into a subtile thridde of an inch long for example, as they cool, do grow bigger and bigger, and consequently shorter and shorter, till at length, they gather themselves back into their main body; and there they settle again in cold bitumen as they were at the first; and the light body that they stick unto, is drawn back with them, and consequently sticketh to the superficies of the bitumen. As if something were tyed at one end of a lutestring extended to its utmost capacity, and the other end were fastened to some pinne; as the string shrinketh up, so that which is tyed at it, must needs move nearer and nearer the pin: which artifice of nature jugglers do imitate, when by means of an unseen hair, they draw light bodies to them. Now if all this operation be done, without your seeing the little thrids w^ch^ cause it; the matter appears wonderfull & strange. But when you consider this progresse that we have set down, you will judge it possible

And this seemeth to be the case of those bodies which we call Electricall; as yellow amber, jet, and the like. All which, are of a bituminous unctuous nature, as appeareth by their easie combustibility & smell, when they are burned. And if some do not so apparently shew this unctuous nature, it is because either they are too hard, or else they have a high degree of aqueous humidity joyned with their unctuosity: and in them the operation will be duller in that proportion; for as we see that unctuous substances are more odoriferous then others, & do send their steams further off, and more effeaciously; so we cannot doubt but that such bodies as consist in a moist nature do accordingly send forth their emanations in a feebler proportion. Yet that proportion will not be so feeble, but that they may have an Electricall effect, as well as the more efficacious Electricall bodies, w^ch^ may be perceptible, if exact experience be made by an instrument like the mariners needle; as our learned countryman D^r^ Gilbert teacheth

But that in those eminent agents, the spirits, whereby they attract, are unctuous, is plain, because the fire consumeth them; and so if the agents be overheated they cannot work; but moderate heat even of fire increaseth their operation. Again, they are clogged by misty aire, or by wetting: and likewise, are pierced through and cut asunder by spirit of wine or aquæ ardentes; but oyl doth not hurt them. Likewise, they yield more spirits in

the sunne then in the shade; and they continue longer, when the aire is cleared by North or by Eastern winds. They require to be polished, either because the rubbing which polisheth them, doth take off from their surfaces the former emanations, which returning back do stick upon them, and so do hinder the passage of those that are within; or else, because their outsides may be foul; or lastly, because the pores may be dilated by that smoothing. Now that hardnesse and solidity is required, doth argue that these spirits must be quick ones, that they may return smartly, and not be lost through their languishing in the aire. Likewise, that all bodies which are not either exceeding rare, or else set on fire, may be drawn by these unctuous thrids; concludeth that the quality by which they do it, is a common one that hath no particular contrarieties; such a one as we see is in grease or in pitch to stick to any thing; from which in like manner nothing is exempted but fire and aire. And lastly, that they work most efficaciously, when they are heated by rubbing, rather then by fire; sheweth that their spirits are excited by motion, and are thereby made to flie abroad; in such manner as we see in pomanders, and in other perfumes, which must be heated if you will have them communicate their sent: & alike effect as in them, agitation doth in jet, yellow amber, & such other Electricall bodies; for if upon rubbing them, you put them presently to your nose, you will discern a strong bituminous smell in them; all wch circumstances do shew that this electricall virtue, consists in a certain degree of rarity or density of the bodies unctuous emanations

Now if these refined and viscuous thrids of jet or amber, do in their streaming abroad meet with a piece of straw, or of hay, or of a dried leaf, or some such light and spungie body; it is no marvail if they glew themselves unto it like birdlime; and that in their shrinking back (by being condensed again and repulsed, through the coldnesse of the aire) they carry it along with them to their entire body. Which they that onely see the effect, and cannot penetrate into a possibility of a naturall cause thereof, are much troubled withall.

9. Cabeus his opinion refuted concerning the cause of Electricall motions.

And this seemeth unto me to bear a fairer semblance of truth, then what Cabeus delivereth for the cause of Electricall attractions. Whose speculation herein, though I cannot allow for solid, yet I must for ingenious. And certainly even errours are to be commended,

commended, when they are witty ones, and do proceed from a casting further about then the beaten track of verball learning, or rather terms which explicate not the nature of the thing in question. He saith that the coming of straws and such other light bodies unto amber, jet, and the like, proceedeth from a wind raised by the forcible breaking out of subtile emanations from the Electricall bodies into the aire, which bringeth those light bodies along with it to the Electricall ones.

But this discourse cannot hold: for first, it is not the nature of unctuous emanations (generally speaking) to cause smart motions singly of themselves. Secondly, although they should raise a wind, I do not comprehend how this wind should drive bodies directly back to the source that raised it; but rather any other way; and so consequently, should drive the light bodies it meeteth with in its way, rather from, then towards the Electricall body. Thirdly, if there should be such a wind raised, & it should bring light bodies to the Electricall ones; yet it could not make them stick thereunto, which we see they do, turn them which way you will, as though they were glewed together.

Neither do his experiences convince any thing; for what he saith that the light bodies are sometimes brought to the Electricall body with such a violence, that they rebound back from it, and then return again to it, maketh rather against him: for if wind were the cause of their motion, they would not return again, after they had leaped back from the Electricall body; no more then we can imagine that the wind it self doth.

The like is of his other experience, when he observed that some little grains of saw-dust hanging at an Electricall body, the furthermost of them not onely fell off, but seemed to be driven away forcibly: for they did not fall directly down, but sideways; and besides did flie away with a violence and smartnesse that argued some strong impulse. The reason whereof might be, that new emanations might smite them, which not sticking and fastening upon them, whereby to draw them nearer, must needs push them further: or it might be that the emanations unto which they were glewed, shrinking back unto their main body, the later grains were shouldered off by others that already besieged the superficies; and then the emanations retiring swiftly the grains must break off with a force: or els we may conceive it was the force

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of the aire that bore them up a little, which made an appearance of their being driven away; as we see feathers and other light things descend not straight down.

## CHAP. XX.

### *Of the Loadstones generation; and its particular motions.*

1. The extreme heat of the sunne under the zodiack, draweth a stream of aire from each pole into the torrid zone.

THere is yet remaining, the great mystery of the Loadstone to discourse of. Which all Authours, both ancient and modern, have agreed upon as an undenyable example and evidence of the shortnesse of mans reach in comprehending, and of the impossibilitie of his reason in penetrating into, and explicating such secrets, as nature hath a mind to hide from us. Wherefore our reader (I am sure) will not in this subject expect clear satisfaction or plain demonstrations, at our hands: but will judge we have fairly acquitted our selves, if what we say be any whit plausible.

Therefore, to use our best indeavours to content him; let us reflect upon the disposition of parts of this habitable globe, whereof we are tenants for lives. And we shall find that the sun by his constant course under the zodiack, heateth a great part of it unmeasurably more then he doth the rest. And consequently, that this zodiack being in the middest between two (as it were) ends, which we call the Poles, these poles must necessarily be extremely cold, in respect of the torrid zone; for so we call that part of the earth which lieth under the zodiack.

Now looking into the consequence of this; we find that the sunne, or the sunnes heat which reflecteth from the earth in the torrid zone, must rarifie the aire extremely, and according to the nature of all heat and fire, must needs carry away from thence, many parts of the aire and of the earth sticking to that heat, in such sort as we have formerly declared.

Whence it followeth, that other aire must necessarily come from the regions towards both the poles, to supply what is carried away from the middle, as is the course in other fires, and as we have explicated above: especially considering, that the aire which cometh from the polewards, is heavier then the aire of the torride zone; and therefore, must naturally presse to be still nearer the earth; and so, as it were shouldereth up the aire

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of

of the torride zone towards the circumference, by rolling into its place: and this, in great quantities; and consequently, the polar aire must draw a great train after it.

Which if we consider the great extent of the torrid zone, we shall easily perswade our selves, that it must reach on each side, to the very pole: for taking from Archimedes, that the spherical superficies of a portion of a sphere, is to the superficies of the whole sphere, according as the parts of the axis of that sphere comprised within the said portion, is to the whole axis: and considering that (in our case) the part of the axis comprised within the torrid zone, is to the whole axis of the earth, in about the proportion of 4. to 10; it must of necessity follow that a fire or great heat reigning in so vast an extent, will draw aire very powerfully from the rest of the world.

Neither let any man apprehend that this course of the sunnes elevating so great quantities of atomes in the torrid zone, should hinder the course of gravity there: for first the medium is much rarer in the torrid zone then in other parts of the earth; & therefore the force of the descending atomes needeth not to be so great there as in other places, to make bodies descend there as fast as they do elsewhere. Secondly, there being a perpetuall supply of fresh aire from the polar parts, streaming continually into the torrid zone; it must of necessity happen that in the aire there come atomes to the torrid zone, of that grossenesse that they cannot suddenly be so much rarified as the subtiler parts of aire that are there: and therefore, the more those subtiler parts are rarified, and thereby happen to be carried up the stronger and the thicker the heavier atomes must descend. And thus this concurse of aire from the polar parts, maintaineth gravity under the zodiack; where otherwise all would be turned into fire, and so have no gravity.

2. The atomes of these two streams coming together are apt to incorporate with one another.

Now, who considereth the two hemispheres which by the equator are divided; will find that they are not altogether of equall complexions: but that our hemisphere, in which the Northpole is comprised, is much dryer then the other, by reason of the greater continent of land in this, and the vaster tract of sea in the other; and therefore the supply which cometh from the divers hemispheres, must needs be of different natures; that which cometh from towards the Southpole, being compared to that

that which cometh from towards the North, as the more wet to the more dry. Yet of how different complexions soever they be, you see they are the emanations of one and the same body. Not unlike unto what nature hath instituted in the rank of animals: among whom, the male & the female are so distinguished by heat and cold, moisture and drought; that nevertheless all belongeth but to one nature; and that, in degrees though manifestly different, yet so near together that the body of one is in a manner the same thing, as the body of the other. Even so, the complexions of the two hemispheres are in such sort different in the same qualities, that nevertheless they are of the same nature, and are unequall parts of the same body which we call the earth. Now Alchimists assure us, that if two extractions of one body do meet together they will incorporate one with the other; especially, if there be some little difference in the complexion of the extractions.

3. By the meeting and mingling together of these streams at the Equator, divers rivolets of atomes of each Pole, are continuared from one Pole to the other.

Whence it followeth that these two streams of aire, making up one continuate floud of various currents, from one end of the world to the other; each stream that cometh to the equator from its own Pole, by the extraction of the sunne, and that is still supplyed with new matter flowing from its own pole to the equator, before the sunne can sufficiently rarifie and lift up the atomes that came first perpendicularly under its beams (as it useth to happen in the effects of Physicall causes, which cannot be rigourously ajusted, but must have some latitude; in which, nature inclineth ever rather to abundance then to defect,) will passe, even to the other pole, by the conduct of his fellow, in case he be by some occasion driven back homewards.

For as we see in a boule or pail full of water, or rather in a pipe, through which the water runneth along; if there be a little hole at the bottome or side of it, the water will wriggle and change its course to creep out at that pipe; especially if there be a little spiggot, or quill at the outside of the hole, that by the narrow length of it helpeth in some sort (as it were) to suck it. So if any of the files of the army or floud of atomes sucked from one of the Poles to the equator, do there find any gappes, or chinks, or lanes of retiring files in the front of the other poles battalia of atomes, they will presse in there: in such manner as we have above declared that water doth by the help of a labell

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of cotton; and as is exemplyfied in all the attractions of venime by venimous bodies whereof we have given many examples above: and they will go along with them the course they go. For as when a thick short guilded ingot of silver is drawn out into a long subtile wyre; the wyre continuing still perfectly guilded all over, doth manifestly shew that the outside and the inside of the ingot, do strangely meet together, and intermix in the drawing out: so this little stream which (like an eddy current) runneth back from the equator towards its own Pole, will continue to the end still tincted with the mixture of the other Poles atomes, it was incorporated with at his coming to the equator.

Now that some little rivolets of aire and atomes should runne back to their own Pole, contrary to the course of their main stream will be easily enough to conceive; if we but consider that at certain times of the year winds do blow more violently and strongly from some determinate part or Rombe of the world, then they do at other times and from other parts. As for example; our East India Mariners tell us of the famous Monsones they find in those parts; which are strong winds that reign constantly six moneths of the year from one polewards, and the other six moneths, from the other pole, & begin precisely about the suns entering into such a signe or degree of the zodiack, and continue till about its entrance into the opposite degree. And in our parts of the world certain smart Easterly or Northeasterly winds do reigne about the end of March & beginning of April; when it seemeth that some snows are melted by the spring heats of the sun. And other winds have their courses in other seasons, upon other causes. All which do evidently convince, that the course of the aire, and of vapours from the poles to the equator, cannot be so regular & uniform, but that many impediments & crosses do light in the way, to make breaches in it; & thereby to force in it some places to an opposite course. In such sort as we see happeneth in eddy waters, & in the course of a tide, wherein the stream rũning swiftly in the middle, beateth the edges of the water to the shore, & thereby maketh it run back at the shore. And hence we may conclude, that although the main course of aire & atomes (for example from north to south, in our hemisphere) can never fail of going on towards the equator, constantly at the same

same rate in grosse; nevertheless, in severall particular little parts of it (& especially at the edges of those streams that are driven on faster then the rest, by an extraordinary and accidentall violent cause) it is variosly interrupted, and sometimes entirely stopped, and other times even driven back to the northwards.

And if peradventure any man should think that this will not fall out, because each stream seemeth to be alwayes coming from his own Pole to the equator, and therefore will oppose and drive back any bodies that with lesse force should strive to swim against it; or if they stick unto them, will carry them back to the equator. We answer, that we must not conceive that the whole aire in body doth every where equally incroch from the polewards upon the torrid zone; but, as it were, in certain brooks or rivolets, according as the contingency of all causes put together doth make it fall out.

Now then out of what we have said it will follow; that since all the aire in this our hemisphere is as it were strewed over and sowed with abundance of northern atomes, & that some brooks of them are in station, others in a motion of retrogradation back to their own north pole; the southern atomes (which coming upon them at the equator do not onely presse in among them, whersoever they can find admittance, but do also go on forwards to the north pole in severall files by themselves, being driven that way by the same accidentall causes, which make the others retire back) seizing in their way upon the northern ones in such manner as we described in filtration; and thereby creeping along by them whersoever they find them standing still, and going along with them whersoever they find them going back; must of necessity find passage in great quantities towards, and even to the north pole; though some parts of them will ever & anon be checked in this their journey by the main current prevailing over some accidentall one, and so be carried back again to the equator, whose line they had crossed.

And this effect cannot choose but be more or lesse according to the seasons of the year: for when the sun is in the Tropick of Capricorn, the southern atomes will flow in much more abundance, and with farre greater speed, into the torrid zone, then the northern atomes can; by reason of the suns approximation to the south, and his distance from the north pole; since he work-

worketh fainteſt, where he is furtheſt off: and therefore from the north no more emanations or atomes will be drawn, but ſuch as are moſt ſubtiliſed, and duly prepared for that courſe. And ſince onely theſe ſelected bands do now march towards the equator, their files muſt needs be thinner, then when the ſunnes being in the equator or Tropick of Cancer wakeneth and muſtereth up all their forces. And conſequently, the quiet parts of aire between their files (in which like atomes are alſo ſcattered) are the greater: whereby the advenient ſouthern atomes have the larger filter to climbe up by. And the like happeneth in the other hemiſphere, when the ſunne is in the Tropick of Cancer; as who will beſtow the pains to compare them, will preſently ſee.

4. Of theſe atomes incorporated with ſome fit matter in the bowels of the earth, is made a ſtone.

Now then let us conſider what theſe two ſtreams thus incorporated muſt of neceſſity do in the ſurface or upper parts of the earth. Firſt, it is evident they muſt needs penetrate a pretty depth into the earth; for ſo freeſing perſwadeth us, and much more, the ſubtile penetration of divers more ſpirituall bodies, of which we have ſufficiently diſcourſed above. Now let us conceive that theſe ſteams do find a body of a convenient denſity to incorporate themſelves in, in the way of denſity, as we ſee that fire doth in iron, and in other denſe bodies: and this not for an houre or two as happeneth in fire; but for years: as I have been told that in the extreme cold hills in the Peak in Darbyſhire happeneth to the dry atomes of cold, which are permanently incorporated in water by long continuall freeſing and ſo make a kind of chryſtall.

In this caſe, certainly it muſt come to paſſe that this body will become in a manner wholly of the nature of theſe ſteams: which becauſe they are drawn from the Poles that abound in cold and dryneſſe, (for others that have not theſe qualities, do not contribute to the intended effect) the body is apteſt to become a ſtone: for ſo we ſee that cold & drought turneth the ſuperficiall parts of the earth into ſtones & rocks; & accordingly, whereſoever cold & dry winds reigne powerfully, all ſuch countries are mainly rocky

5. This ſtone worketh by emanations, joyned with agreeing ſtreams that meet them in the aire; and in fire it is a load-ſtone.

Now then let us ſuppoſe, this ſtone to be taken out of the earth and hanged in the aire, or ſet conveniently upon ſome little pin, or otherwiſe put in liberty, ſo as a ſmall impulſe may eaſily turn it any way: it will in this caſe certainly follow, that the end

end of the stone which in the earth lay towards the north pole, will now in the aire convert it self in the same manner towards the same point; and the other end which lay towards the south, turn by consequence to the south. I speak of these countries which lie between the equator and the north; in which it cannot chuse but that the stream going from the north to the equator, must be stronger then the opposite one.

Now to explicate how this is done; suppose the stone hanged east and west freely in the aire; the stream which is drawn from the north pole of the earth rangeth along by it in its course to the equator; and finding in the stone the south steam, (which is grown innate to it) very strong, it must needs incorporate it self with it; and most, by those parts of the steam in the stone which are strongest: which are they that come directly from the North of the stone; by which I mean that part of the stone that lay northward in the earth, and that still looketh to the north pole of the earth now it is in the aire. And therefore the great floud of atomes coming from the north pole of the earth will incorporate it self most strongly, by the north end of the stone with the little floud of southern atomes it findeth in the stone: for that end serveth for the coming out of the southern atomes, and sendeth them abroad; as the south end doth the northern steam, since the steams do come in at one end, and do go out at the opposite end.

From hence we may gather, that this stone will joyn and cleave to its attractive, whensoever it happeneth to be within the sphere of its activity. Besides, if by some accident it should happen that the atomes or steams which are drawn by the sunne from the Polewards to the equator, should come stronger from some part of the earth, which is on the side hand of the Pole, then from the very Pole it self; in this case the stone will turn from the Pole towards that side. Lastly, whatsoever this stone will do towards the Pole of the earth; the very same a lesser stone of the same kind will do towards a greater. And if there be any kind of other substance that hath participation of the nature of this stone, such a substance will behave it self towards this stone, in the same manner, as such a stone behaveth it self towards the earth: all the Phenomens whereof may be the more plainly observed, if the stone be cut into the form of the earth.

And

And thus, we have found a perfect delineation of the load-ſtone from its cauſes: for there is no man ſo ignorant of the nature of a loadſtone, but he knoweth that the properties of it are to tend towards the North; to vary ſometimes; to joyn with another load-ſtone; to draw iron unto it; and ſuch like, whoſe cauſes you ſee delivered.

6. A methode for making experiences upon any ſubject.

But to come to experimentall proofs and obſervations upon the load-ſtone by which it will appear, that theſe cauſes are well eſteemed and applyed, we muſt be beholding to that admirable ſearcher of the nature of the load-ſtone Doctour Gilbert; by means of whom and of Doctour Harvey, our Nation may claim even in this latter age as deſerved a crown for ſolid Philoſophicall learning, as for many ages together it hath done formerly for acute and ſubtile ſpeculations in Divinity. But before I fall to particulars, I think it worth warning my Reader, how this great man arrived to diſcover ſo much of Magneticall Philoſophy; that he likewiſe, if he be deſirous to ſearch into nature, may by imitation advance his thoughts & knowledge that way.

In ſhort then, all the knowledge he got of this ſubject, was by forming a little load-ſtone into the ſhape of the earth. By which means he compaſſed a wonderfull deſigne, which was, to make the whole globe of the earth maniable: for he found the properties of the whole earth, in that little body; which he therefore called a Terrella, or little earth; and which he could manage and try experiences upon, at his will. And in like manner, any man that hath an aim to advance much in naturall ſciencies, muſt endeavour to draw the matter he enquireth of, into ſome ſmall modell, or into ſome kinde of manageable method; which he may turn and wind as he pleaſeth. And then let him be ſure, if he hath a competent underſtanding, that he will not miſſe of his mark.

7. The loadſtones generation by atomes flowing from both Pole, is confirmed by experimentes obſerved in the ſtone it ſelf.

But to our intent; the firſt thing we are to prove is, that the load-ſtone is generated in ſuch ſort as we have deſcribed: for proof whereof, the firſt ground we will lay ſhall be to conſider how in divers other effects it is manifeſt, that the differences of being expoſed to the north or to the ſouth, do cauſe very great variety in the ſame thing: as hereafter, we ſhall have occaſion to touch, in the barks and grains of trees, and the like. Next, we find by experience, that this virtue of the load-ſtone is received

into other bodies that resemble its nature, by heatings and coolings: for so it passeth in iron barres, which being throughly heated, and then laid to cool north and south, are thereby imbued with a Magnetick virtue; heat opening their bodies, and disposing them to suck in, such atomes as are convenient to their nature, that flow unto them whiles they are cooling. So that we cannot doubt, but that convenient matter fermenting in its warm bed under the earth, becometh a load-stone by the like sucking in of affluent streams of a like complexion to the former.

And it fareth in like manner with those fiery instruments (as fireforks, tongues, shovels, and the like) which do stand constantly upwards and downwards; for they, by being often heated and cooled again, do gain a very strong verticity, or turning to the Pole: and indeed, they cannot stand upwards and downwards so little a while, but that they will in that short space gain a manifest verticity; and change it at every turning. Now since the force and vigour of this verticity, is in the end that standeth downwards; it is evident that this effect proceedeth out of an influence received from the earth.

And because in a load-stone (made into a globe, or considered so, to the end you may reckon hemispheres in it, as in the great earth) either hemisphere giveth unto a needle touched upon it, not onely the virtue of that hemisphere where it is touched, but likewise the virtue of the contrary hemisphere; we may boldly conclude, that the virtue which a load-stone is impregnated with in the wombe or bed of the earth, where it is formed and groweth, proceedeth as well from the contrary hemisphere of the earth, as from that wherein it lyeth; in such sort, as we have above described. And as we feel oftentimes in our own bodies, that some cold we catch remaineth in us a long while after the taking it, and that sometimes it seemeth even to change the nature of some part of our body into which it is chiefly entered, and hath taken particular possession of; so that whensoever new atomes of the like nature, do again range about in the circumstant aire, that part so deeply affected with the former ones of kinne to these, doth in a particular manner seem to risent them, and to attract them to it, and to have its guests within it (as it were) wakened and roused up by the strokes of the advenient ones that knock at their dores. Even so (but much more

strongly

ſtrongly; by reaſon of the longer time and leſſe hinderances) we may conceive that the two virtues or atomes proceeding from the two different hemiſpheres, do conſtitute a certain permanent and conſtant nature in the ſtone that imbibeth them: which then, we call a load-ſtone; and is exceeding ſenſible (as we ſhall hereafter declare) of the advenience to it of new atomes, alike in nature & complexion to thoſe that it is impregnated with

And this virtue, conſiſting in a kind of ſofter and tenderer ſubſtance then the reſt of the ſtone, becometh thereby ſubject to be conſumed by fire. From whence we may gather the reaſon why a load-ſtone never recovereth its magnetick virtue, after it hath once loſt it; though iron doth; for the humidity of iron is inſeparable from its ſubſtance, but the humidity of a load-ſtone, which maketh it capable of this effect, may be quite conſumed by fire; and ſo the ſtone may be left too dry, for ever being capable of imbibing any new influence from the earth, unleſſe it be by a kind of new making it.

8. Experiments to prove that the loadſtone worketh by emanations meeting with agreeing ſtreams.

In the next place we are to prove that the load-ſtone doth work in that manner as we have ſhewed: for which end let us conſider how the atomes that are drawn from each Pole and hemiſphere of the earth to the equatour, making up their courſe by a manuduction of one another, the hindermoſt cannot chooſe but ſtill follow on after the foremoſt. And as it happeneth in filtration by a cotton cloth; if ſome one part of the cotton, have its diſpoſition to the aſcent of the water, more perfect and ready then the other parts have; the water will aſſuredly aſcend faſter in that part, then in any of the reſt: ſo, if the atomes do find a greater diſpoſition for their paſſage, in any one part of the medium they range through, then in another, they will certainly not fail of taking that way, in greater abundance, and with more vigour and ſtrength, then any other.

But it is evident, that when they meet with ſuch a ſtone as we have deſcribed, the helps by which they advance in their journey are notably encreaſed by the floud of atomes which they meet coming out of that ſtone; which being of the nature of their oppoſite pole, they ſeiſe greedily upon them, and thereby do pluck themſelves faſter on: like a ferryman that draweth on his boat the ſwiftlier, the more vigourouſly he tuggeth & pulleth at the rope that lyeth thwart the river for him to hale himſelf

over by. And therefore we cannot doubt but that this floud of atomes streaming from the pole of the earth, must needs passe through that stone with more speed and vigour then they can do any other way.

And as we see in the running of water; that if it meeteth with any lower cranies then the wide channel it streameth in; it will turn out of its straight way, to glide along there where it findeth an easier and more deelive bed to tumble in: so these atomes will infallibly deturn themselves from their direct course, to passe through such a stone as farre as their greater conveniency leadeth them.

And what we have said of these atomes, which from the Poles do range through the vast sea of aire to the equator; is likewise to be applyed unto those atomes which issue out of the stone: so that we may conclude, that if they meet with any help which may convey them on with more speed and vigour, then whiles they stream directly forwards; they will likewise deturn themselves from directly forwards, to take that course. And if the stone it self be hanged so nicely, that a lesse force is able to turn it about then is requisite to turn awry out of its course the continued stream of atomes which issueth from the stone: in this case, the stone it self must needs turn towards that stream which climbing and filtring it self along the stones stream, draweth it out of its course; in such sort as the nose of a weathercock butteth it self into the wind. Now then; it being known, that the strongest stream cometh directly from the north in the great earth, & that the southern stream of the Terrella or load-stone proportioned duely by nature to incorporate with the north stream of the earth, issueth out of the north end of the stone; it follows plainly that when a loadstone is situated at liberty, its north end must necessarily turn towards the north pole of the world.

And it will likewise follow, that whensoever such a stone meeteth with another of the same nature and kind, they must comport themselves to one another in like sort: that is, if both of them be free and equall, they must turn themselves to, or from one another; according as they are situated in respect of one another. So that if their axes be parallel, and the south pole of the one, and the north of the other do look the same way, then they will send proportionate, and agreeing streams to one another from

from their whole bodies, that will readily mingle and incorporate with one another, without turning out of their way or seeking any shorter course or changing their respects to one another

But if the poles of the same denomination do look the same way, and the loadstones do not lie in such sort as to have their axes parallel, but that they encline to one another: then they will work themselves about, untill they grow by their opposite poles into a straight line; for the same reason as we have shewed of a loadstones turning to the pole of the earth.

But if onely one of the loadstones be free & the other be fixed, & that they lie inclined, as in the former case; then, the free stone will work himself untill his pole be opposite to that part of the fixed stone from whence the stream wch agrees with him, issueth strongest: for that stream is to the free loadstone, as the northern stream of the earth, is to a loadstone compared unto the earth. But withall, we must take notice that in this our discourse, we abstract from other accidents; & particularly, frō the influence of the earths streams into the loadstones: wch will cause great variety in these cases, if they lie not due north & south, when they begin to work.

And as loadstones and other magnetick bodies, do thus of necessity turn to one another when they are both free; and if one of them be fastened, the other turneth to it; so likewise, if they be free to progressive motion, they must by a like necessity and for the same reason, come together and joyn themselves to one another. And if onely one of them be free, that must remove it self to the other: for the same virtue that maketh them turn, (which is, the strength of the steam) will likewise (in due circumstances) make them come together; by reason that the steams which climbe up one another by the way of filtration, and do thereby turn the bodies of the stones upon their centers when they are onely free to turn, must likewise draw the whole bodies of the stones entirely out of their places, & make them joyn, when such a totall motion of the body is an effect that requireth no more force, then the force of conveying vigorously the streams of both the Magnetick bodies into one another; that is, when there is no such impediment standing in the way of the Magnetick bodies motion, but that the celerity of the atomes motion, mingling with one another, is able to overcome it: for then, it must needs do so; & the magnetick body by naturall cōherence unto the steam

of atomes in which it is involved, followeth the course of the steam: in such sort as the example we have heretofore upon another occasion given of an eggs-shell filled with dew; the sunbeams converting the dew into smoke, and raising up that smoke or steam, the eggs-shell is likewise raised up for company with the steam that issueth from it.

And for the same reason it is, that the loadstone draweth iron: for iron being of a nature apt to receive and harbour the steams of a loadstone; it becometh a weak loadstone, and worketh towards a loadstone, in such sort as a weaker loadstone would do: and so moveth towards a loadstone by the means we have now described. And that this conformity between iron and the loadstone is the true reason of the loadstones drawing of iron, is clear out of this, that a loadstone will take up a greater weight of pure iron, then it will of impure or drossie iron; or of iron and some other metall joyned together: and that it will draw further through a slender long iron, then in the free open aire: all which are manifest signes, that iron cooperateth with the force which the loadstone grafteth in it. And the reason why iron cometh to a loadstone more efficaciously then another loadstone doth, is because loadstones generally are more impure then iron is (as being a kind of ore or mine of iron) and have other extraneous and heterogeneall natures mixed with them: whereas iron receiveth the loadstones operation in its whole substance.

## CHAP. XXI.

### *Positions drawn out of the former doctrine, and confirmed by experimentall proofs.*

1. The operations of the loadstone are wrought by bodies and not by qualities.

THe first position is, that the working of the loadstone, being throughout according to the tenour of the operation of bodies, may be done by bodies, and consequently is not done by occult or secret qualities. Which is evident out of this, that a greater loadstone hath more effect then a lesser: and that if you cut away part of a loadstone, part of his vertue is likewise taken from him: and if the parts be joyned again, the whole becometh as strong as it was before.

Again, if a loadstone touch a longer iron, it giveth it lesse force then if it touch a shorter iron: nay, the vertue in any part is

is sensibly lesser, according as it is further from the touched part.

Again, the longer an iron is in touching, the greater vertue it getteth, and the more constant. And both an iron and a loadstone may lose their vertue, by long lying out of their due order and situation, either to the earth or to another loadstone.

Besides, if a loadstone do touch a long iron in the middle of it, he diffuseth his vertue equally towards both ends; and if it be a round plate, he diffuseth his vertue equally to all sides.

And lastly, the vertue of a loadstone, as also of an iron touched, is lost by burning it in the fire. All which symptomes agreeing exactly with the rules of bodies, do make it undeniable that the vertue of the loadstone is a reall and solid body.

2. Objections against the former position answered.

Against this position, Cabeus objecteth that little atomes would not be able to penetrate all sorts of bodies; as we see the vertue of the loadstone doth. And urgeth, that although they should be allowed to do so, yet they could not be imagined to penetrate thick and solid bodies so suddenly, as they would do thin ones; and would certainly shew then some signe of facility or difficulty of passing, in the interposition and in the taking away of bodies put between the loadstone and the body it works upon. Secondly, he objecteth that atomes being little bodies, they cannot move in an instant; as the working of the loadstone seemeth to do. And lastly, that the loadstone by such abundance of continuall evaporations, would quickly be consumed.

To the first we answer; That atomes whose nature it is to pierce iron, cannot reasonably be suspected of inability to penetrate any other body: and that atomes can penetrate iron, is evident in the melting of it by fire. And indeed this objection cometh now too late, after we have so largely declared the divisibility of quantity, and the subtilty of nature in reducing all things into extreme small parts: for this difficulty hath no other avow, then the tardity of our imaginations in subtilizing sufficiently the quantitative parts that issue out of the loadstone.

As for any tardity that may be expected by the interposition of a thick or dense body; there is no appearance of such, since we see light passe through thick glasses without giving any signe of meeting with the least opposition in its passage, (as we have above declared at large:) and magneticall emanations have the advantage of light in this, that they are not obliged to straight lines, as light is.

Lastly, as for loadstones spending of themselves by still venting their emanations; odoriferous bodies furnish us with a full answer to that objection: for they do continue many years palpably spending of themselves, and yet keep their odour in vigour; whereas a loadstone, if it be laid in a wrong position will not continue half so long. The reason of the duration of both which, maketh the matter manifest and taketh away all difficulty: which is, that as in a root of a vegetable, there is a power to change the advenient juyce into its nature; so is there in such like things as these a power to change the ambient aire into their own substance: as evident experience sheweth in the Hermetike salt, (as some modern writers call it) which is found to be repaired, and encreased in its weight by lying in the aire; and the like happeneth to saltpeter. And in our present subject experience informeth us, that a loadstone will grow stronger by lying in due position either to the earth, or to a stronger loadstone, whereby it may be better impregnated, and as it were feed it self with the emanations issuing out of them into it.

3. The loadstone is imbued with his virtue from another body.

Our next position is, that this virtue cometh to a magnetick body, from another body; as the nature of bodies is, to require a being moved, that they may move. And this is evident in iron, which by the touch or by standing in due position near the loadstone, gaineth the power of the loadstone. Again, if a smith in beating his iron into a rod, do observe to lay it north & south; it getteth a direction to the north by the very beating of it. Likewise if an iron rod be made red hot in the fire, and be kept there a good while together, and when it is taken out be laid to cool just north and south, it will acquire the same direction towards the north. And this is true not onely of iron, but also of all other sorts of bodies whatsoever that endure such ignition: particularly of pot-earths, which if they be moulded in a long form, and when they are taken out of the kiln be laid (as we said of the iron) to cool north and south, will have the same effect wrought in them. And iron, though it hath not been heated; but onely hath continued long unmoved in the same situation of north and south in a building; yet it will have the same effect. So as it cannot be denied, but that this virtue cometh unto iron from other bodies: whereof one must be a secret influence from the north. And this is confirmed, by a loadstones losing its virtue (as

we

we said before) by lying a long time unduly disposed, either towards the earth, or towards a stronger loadstone; whereby in stead of the former, it gaineth a new virtue according to that situation.

And this happeneth, not onely in the virtue which is resident and permanent in a loadstone, or a touched iron; but likewise in the actuall motion or operation of them. As may be experienced, first in this, that the same loadstone or touched iron in the south hemisphere of the world, hath its operation strongest at that end of it which tendeth to the north; and in the north hemisphere at the end which tendeth to the south: each pole communicating a vigour proportionable to its own strength in the climate where it is received. Secondly in this, that an iron joyned to a loadstone, or within the sphere of the loadstones working, will take up another piece of iron greater then the loadstone of it self can hold; and as soon as the holding iron is removed out of the sphere of the loadstones activity, it presently letteth fall the iron it formerly held up: and this is so true, that a lesser loadstone may be placed in such sort within the sphere of a greater loadstones operation, as to take away a piece of iron from the greater loadstone; & this in virtue of the same greater loadstone from which it plucketh it: for, but to remove the lesser out of the sphere of the greater, and then it can no longer do it. So that it is evident that in these cases the very actuall operation of the lesser loadstone or of the iron; proceedeth from the actuall influence of the greater loadstone upon and into them. And hence we may understand, that whensoever a magnetick body doth work, it hath an excitation from without, which doth make it issue out and send its streams abroad; in such sort as it is the nature of all bodies to do; and as we have given examples of the like done by heat, when we discoursed of Rarefaction.

But to explicate this point more clearly by entring more particularly into it; if a magnetick body lieth north and south, it is easie & obvious to conceive that the streams coming from north and south of the world, and passing through the stone must needs excitate the virtue which is in it, and carry a stream of it along with them that way they go. But if it lieth east and west, then the steams of north & south of the earth, streaming along by the two poles of the stone, are sucked in by them much more weakly: yet

yet nevertheleſſe ſufficiently to give an excitation to the innate ſteams which are in the body of the ſtone, to make them move on in their ordinary courſe.

4. The virtue of the loadſtone is a double, and not one ſimple virtue.

The third poſition is, that the virtue of the loadſtone is a double and not one ſimple virtue. Which is manifeſt in an iron touched by a loadſtone, for if you touch it onely with one pole of the ſtone, it will not be ſo ſtrong and full of the magnetike virtue, as if you touch one end of it with one pole, and the other end of it with the other pole of the ſtone. Again, if you touch both ends of an iron, with the ſame pole of the ſtone, the iron gaineth its virtue at that end which was laſt touched; and changeth its virtue from end to end, as often as it is rubbed at contrary ends. Again, one end of the loadſtone or of iron touched, will have more force on the one ſide of the equatour, and the other end on the other ſide of it. Again, the variation on the one ſide of the equator, and the variation on the other ſide of it, have different lawes according to the different ends of the loadſtone, or of the needle, which looketh to thoſe poles.

Wherefore it is evident, that there is a double virtue in the loadſtone, the one more powerfull at the one end of it; the other more powerfull at the other end. Yet theſe two virtues are found in every ſenſible part of the ſtone: for cutting it at either end, the virtue at the contrary end is alſo diminiſhed. And the whole loadſtone that is left, hath both the ſame virtues, in proportion to its bigneſſe. Beſides, cut the loadſtone how you will, ſtill the two poles remain in that line, which lay under the meridian when it was in the earth. And the like is of the touched iron whoſe virtue ſtill lieth along the line, which goeth ſtraight (according to the line of the axis) from the point where it was touched, and at the oppoſite end, conſtituteth the contrary pole.

5. The virtue of the loadſtone worketh more ſtrongly in the poles of it, then in any other part.

The fourth poſition is, that though the virtue of the loadſtone be in the whole body; nevertheleſſe, its virtue is more ſeen in the poles then in any other parts. For by experience it is found that a loadſtone of equall bulk, worketh better and more efficaciouſly if it be in a long form; then if it be in any other. And from the middle line betwixt the two poles, there cometh no virtue, if an iron be touched there: but any part towards the pole; the nearer it is to the pole, the greater party it imparteth. Laſtly, the declination teacheth us the ſame; which is ſo much the ſtronger by how much it is nearer the pole.

The

The fifth position is, that in the loadstone there are emanations which do issue not onely at the poles and about them, but also spherically, round about the whole body, and in an orbe from all parts of the superficies of it; in such sort as happeneth in all other bodies whatsoever. And that these spherical emanations are of two kinds; proportionable to the two polar emanations. And that the greatest force of each sort of them is in that hemisphere where the pole is, at which they make their chief issue.

6. The loadstone sendeth forth its emanations spherically. Which are of two kinds: and each kind is strongest in that hemisphere, through whose polary parts they issue out.

The reason of the first part of this position is, because no particular body can be exempt from the lawes of all bodies: and we have above declared that every physicall body must of necessity have an orb of fluours, or [illegible] activity about it. The reason of the second part is, that seeing these fluours do proceed of the very substance and nature of the loadstone, they cannot choose but be found of both sorts, in every part how little soever it be, where the nature of the loadstone resideth. The reason of the third part is, that because the polar emanations do tend wholly towards the poles (each of them to their proper pole) it followeth that in every hemisphere both those which come from the contrary hemisphere, and those which are bred in the hemisphere they go out at, are all assembled in that hemisphere: and therefore of necessity it must be stronger in that kind of fluours, then the opposite end is. All which appeareth true in experience: for if a long iron toucheth any part of that hemisphere of a loadstone which tendeth to the north; it gaineth at that end a virtue of tending likewise to the north: and the same will be if an iron but hang close over it. And this may be confirmed by a like experience, of an iron barre in respect of the earth which hanging downwards in any part of our hemisphere, is imbued with the like inclination of drawing towards the north.

The sixth position is, that although every part of one loadstone do *in it self* agree with every part of another loadstone (that is, if each of these parts were divided from their wholes, and each of them made a whole by it self, they might be so joyned together as they would agree) nevertheless, when the parts are in their two wholes; they do not all of them agree together: but of two loadstones, only the poles of the one do agree with the whole body of the other; that is, each pole with any part of the contrary hemisphere of the other loadstone.

7. Putting two loadstons within the sphere of one another, every part of one loadstone doth not agree with every part of the other loadstone.

The

The reason of this is, because the fluours which issue out of the stones, are in certain different degrees in severall parts of the entire loadstones; whereby it happeneth that one loadstone can work by a determinate part of it self most powerfully upon the other, if some determinate part of that other do lie next unto it; and not so well, if any other part lieth towards it. And accordingly experience sheweth that if you put the pole of a loadstone towards the middle of a needle that is touched at the point, the middle part of the needle will turn away, and the end of it will convert it self to the pole of the loadstone.

8. Concerning the declination and of a needle, towards the loadstone it toucheth.

The seventh position is, that if a touched needle and a loadstone do come together, and [illegible] one another in their agreeing [illegible] whatsoever parts of them those be) the line of the needles length will bend towards the pole of the stone (excepting, if they touch by the equator of the stone, and the middle of the needle:) yet not so that if you draw out the line of the needles length, it will go through the pole of the stone; unless they touch by the end of the one, and the pole of the other. But if they touch by the equator of the one and the middle of the other, then the needle will lie parallele to the axis of the stone.

And the reason of this is manifest, for in that case the two poles being equidistant to the needle they draw it equally; and by consequence the needle must remain parallele to the axis of the stone. Nor doth it import that the inequality of the two poles of the stone is materially or quantitatively greater then the inequality of the two poles of the needle; out of which it may at the first sight seem to follow, that the stronger pole of the stone should draw the weaker pole of the needle nearer unto it self; then the weaker pole of the stone can be able to draw the stronger pole of the needle: and by consequence that the needle should not lie parallele to the axis of the stone, but should incline somewhat to the stronger pole of it. For after you have wel considered the matter, you will find that the strength of the pole of the stone, cannot work according to its materiall greatnesse, but is confined to work onely according to the susceptibility of the needle: the which, being a slender and thin body, cannot receive so much as a thicker body may. Wherefore, seeing that the strongest pole of the stone giveth most strength to that pole of the needle, which lieth furthest from it; it may well happen that

that this superiority of strength in the pole of the needle that is applied to the weaker pole of the stone, may counterpoise the excesse of the stronger pole of the stone, over its opposite weaker pole; though not in greatnesse and quantity, yet in respect of the virtue which is communicable to the poles of the needle; whereby its comportment to the poles of the stone is determined. And indeed the needles lying parallele to the axis of the stone when the middle of it sticketh to the equator of the stone, convinceth that upon the whole matter, there is no excesse in the efficacious working of either of the stones poles: but that their excesse over one another in regard of themselves is balanced by the needles receiving it.

But if the needle hapneth to touch the loadstone in some part nearer one pole then the other; in this case it is manifest that the force of the stone is greater on the one side of the needles touch, then on the other side; because there is a greater quantity of the stone on the one side of the needle then on the other: and by consequence the needle will incline that way which the greater force draweth it; so far forth as the other part doth not hinder it. Now we know that if the greater part were divided from the rest, and so were an entire loadstone by it self (that is, if the loadstone were cut off where the needle toucheth it) then the needle would joyn it self to the pole that is to the end, of that part: and by consequence, would be tending to it, in such sort as a thing that is sucked tendeth towards the sucker against the motion or force which cometh from the lesser part: and on the other side the lesser part of the stone which is on the other side of the point which the needle toucheth, must hinder this inclination of the needle according to the proportion of its strength; and so it followeth, that the needle will hang by its end, not directly set to the end of the greater part, but as much inclining towards it as the lesser part doth not hinder by striving to pull it the other way. Out of which we gather the true cause of the needles declination, to wit the proportion of working of the two unequall parts of the stone, between which it toucheth and is joyned to the stone.

9. The virtue of the loadstone goeth from end

And we likewise discover their errour who judge that the part which draweth iron is the next pole unto the iron. For it is rather the contrary pole which attracteth; or to speak more pro-

to end in lines almost parallele to the axis.

properly it is the whole body of the stone as streaming in lines almost parallele to the axis, from the furthermost end, to the other end wch is next to the iron: and (in our case) it is that part of the stone which beginneth from the contrary pole and reacheth to the needle. For besides the light which this discourse gave us, experience assureth us that a loadstone, whose poles lie broadwayes, not longwayes, the stone is more imperfect, and draweth more weakly then if the poles lay longwayes; which would not be if the fluours did stream from all parts of the stone directly to the pole: for then, howsoever the stone were cast the whole virtue of it would be in the poles. Moreover, if a needle were drawn freely upon the same meridian from one pole to the other, as soon as it were passed the equator, it would leap suddenly at the very first remove of the equator, where it is parallele with the axis of the loadstone, from being so parallele, to make an angle with the axis greater then a half right one, to the end that it might look upon the pole which is supposed to be the onely attractive that draweth the needle: which great change, wrought all at once, nature never causeth nor admitteth, but in all actions or motions, useth to passe through all the mediums whensoever it goeth from one extreme to another. Besides, there would be no variation of the needles aspect towards the north end of the stone: for if every part did send its virtue immediately to the poles, it were impossible that any other part whatsoever should be stronger then the polar part, seeing that the polar part had the virtue even of that particular part, and of all the other parts of the stone besides, joyned in it self.

This therefore is evident; that the virtue of the loadstone goeth from end to end in parallele lines; unlesse it be in such stones as have their polar parts narrower then the rest of the body of the stone: for in them, the stream will tend with some little declination towards the pole, as it were by way of refraction; because without the stone, the fluours from the pole of the earth do coarct themselves, and so do thicken their stream, to croud into the stone as soon as they are sensible of any emanations from it, that being (as we have said before) their readiest way to passe along: and within the stone, the stream doth the like to meet the advenient stream where it is strongest and thickest; which is, at that narrow part of the stones end, which is most prominent out.

And

And by this discourse we discover likewise another errour of them that imagine the loadstone hath a sphere of activity round about it, equall on all sides; that is, perfectly spherical, if the stone be spherical. Which clearly is a mistaken speculation: for nature having so ordered all her agents that where the strength is greatest, there the action must (generally speaking) extend it self furthest off; and it being acknowledged that the loadstone hath greatest strength in its poles and least in the equator; it must of necessity follow, that it worketh further by its poles, then by its equator. And consequently, it is impossible that its sphere of activity should be perfectly spherical.

10. The virtue of the loadstone is not perfectly spherical though the stone be such.

Nor doth Cabeus his experience move us to conceive the loadstone hath a greater strength to retain an iron laid upon it by its equator, then by its poles: for to justifie his assertion, he should have tried it in an iron wyre that were so short as the poles could not have any notable operation upon the ends of it; since otherwise, the force of retaining it will be attributed to the poles (according to what we have above delivered) & not to the equator

The eighth position is, that the intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and the attracted bodies. Which is evident out of the sticking of them together: as also out of the violence wherewith iron cometh to a loadstone; which when it is drawn by a powerfull one, is so great, that through the force of the blow hitting the stone, it will rebound back again, and then fall again to the stone: and in like manner a needle upon a pinne, if a loadstone be set near it, turneth with so great a force towards the pole of the stone, that it goeth beyond it, and coming back again, the celerity wherewith it moveth maketh it retire it self too far on the other side; and so by many undulations, at the last it cometh to rest directly opposite to the pole. Likewise, by the declination; by means of which, the iron to the stone, or the stone to the earth, approacheth in such a disposition as is most convenient to joyn the due ends together. And lastly, out of the flying away of the contrary ends from one another: which clearly is to no other purpose, but that the due ends may come together. And in generall, there is no doubt but ones going to another, is instituted by the order of nature for their coming together, & for their being together, which is but a perseverance of their coming together.

11. The intention of nature in all the operations of the loadstone, is to make an union betwixt the attractive and attracted bodies.

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12. The main globe of the earth is not a loadstone

The ninth position is, that the nature of a loadstone doth not sink deeply into the main body of the earth, as to have the substance of its whole body be magneticall, but onely remaineth near the surface of it. And this is evident by the inequality in virtue of the two ends; for if this magnetick virtue were the nature of the whole body, both ends would be equally strong. Nor would the disposition of one of the ends be different from the disposition of the other. Again, there could be no variation of the tending towards the north: for the bulk of the whole body would have a strength so eminently greater then the prominences and disparities of hils or seas, as the varieties of these would be absolutely insensible. Again, if the motion of the loadstone came from the body of the earth, it would be perpetually from the center, and not from the poles; and so, there could be no declinatiõ more in one part of the earth, then in another. Nor would the loadston tend from north to south, but from the center to the circumference; or rather from the circumference to the center.

And so we may learn the difference between the loadstone and the earth in their attractive operations; to wit, that the earth doth not receive its influence from another body, nor doth its magnetike virtue depend of another magnetike agent, that impresseth it into it: which nevertheless, is the most remarkable condition of a loadstone. Again, the strongest virtue of the loadstone, is from pole to pole: but the strongest virtue of the earth, is from the center upwards, as appeareth by fireforks gaining a much greater magnetike strength in a short time, then a loadstone in a longer. Neither can it be thence objected, that the loadstone should therefore receive the earths influences more strongly from the centerwards, then from the poles of the earth, (which by its operation, and what we have discoursed of it, is certain it doth not;) since the beds where loadstones lie and are formed be towards the bottome of that part or back of the earth which is inbued with magnetike virtue. Again, this virtue which we see in a loadstone, is substantiall to it; whereas the like virtue is but accidentall to the earth, by means of the suns drawing the northern and southern exhalations to the equator.

13. The loadstone is generated in all parts or climats of the earth.

The last position is, that the loadstone must be found over all the earth, and in every country. And so we see it is: both because iron mines are found (in some measure) almost in all countries: &

because,

cause, at the least other sorts of earth (as we have declared of potearths) cannot be wanting in any large extent of country; which when they are baked and cooled in due positions, have this effect of the loadstone, and are of the nature of it. And Doctour Gilbert sheweth, that the loadstone is nothing else but the ore of steel or of perfectest iron, and that it is to be found of all colours, and fashions, and almost of all consistences.

14. The conformity betwixt the two motions of magnetick things, and of heavy things.

So that we may easily conceive, that the emanations of the loadstone being every where, as well as the causes of gravity; the two motions of magnetick things and of weighty things, do both of them derive their origine from the same source; I mean, from the very same emanations coming from the earth; which by a divers ordination of nature, do make this effect in the loadstone, and that other in weighty things. And who knoweth but that a like sucking to this which we have shewed in magnetick things, passeth also in the motion of gravity? In a word; gravity beareth a fair testimony in the behalf of the magnetick force; and the loadstones working returneth no mean verdict for the causes of gravity, according to what we have delivered of them.

## CHAP. XXII.

*A solution of certain Problemes concerning the loadstone, and a short summe of the whole doctrine touching it.*

1. Which is the North, and which the South Pole of a loadstone.

Out of what is said upon this subject, we may proceed to the solution of certain questions or problemes, which are or may be made in this matter. And first, of that which Doctour Gilbert disputeth against all former writers of the loadstone; to wit, which is the North, and which the South pole of a stone? Which seemeth unto me, to be onely a question of the name: for if by the name of north and south, we understand that end of the stone which hath that virtue that the north or south pole of the earth have, then it is certain, that the end of the stone which looketh to the south pole of the earth, is to be called the north pole of the loadstone; and contrariwise, that which looketh to the north, is to be called the south pole of it. But if by the names of north and south pole of the stone, you mean those ends of it, that lie and point to the north and to the south

poles of the earth; then you must reckon their poles contrariwise to the former account. So that the termes being once defined, there will remain no further controversie about the point.

2. Whether any bodies besides magnetick ones be attractive.

Doctour Gilbert seemeth also to have another controversie with all writers; to wit, whether any bodies besides magneticall ones be attractive? Which he seemeth to deny; all others to affirm. But this also being fairly put, will peradventure prove no controversie: for the question is either in common, of attraction; or else in particular, of such an attraction as is made by the loadstone. Of the first part, there can be no doubt; as we have declared above; and as is manifest betwixt gold and quicksilver, when a man holding gold in his mouth, it draweth unto it the quicksilver that is in his body. But for the attractive to draw a body unto it self, not wholly, but one determinate part of the body drawn, unto one determinate part of the drawer; is an attraction which for my part I cannot exemplifie in any other bodies but magneticall ones.

3. Whether an iron placed perpendicularly towards the earth doth get a magnetical virtue of pointing towards the north, or towards the south in that end that lyeth downwards.

A third question is, whether an iron that standeth long time unmoved in a window, or any other part of a building, perpendicularly to the earth, doth contract a magneticall virtue of drawing or pointing towards the north in that end which looketh downwards. For Cabeus (who wrote since Gilbert) affirmeth it out of experience: but either his experiment or his expression was defective. For assuredly if the iron standeth so, in the northern hemisphere, it will turn to the north; and if in the southern hemisphere, it will turn to the south: for seeing the virtue of the loadstone proceedeth from the earth, and that the earth hath different tempers towards the north, and towards the south pole (as hath been already declared) the virtue which cometh out of the earth in the northern hemisphere, will give unto the end of the iron next it an inclination to the north pole; and the earth of the southern hemisphere will yield the contrary dispositon unto the end which is neerest it.

4. Why loadstones affect iron better then one another.

The next question is, why a loadstone seemeth to love iron better then it doth another loadstone? The answer is, because iron is indifferent in all its parts to receive the impression of a loadstone; whereas another loadstone receiveth it onely in a determinate part: and therefore a loadstone draweth iron more easily then it can another loadstone; because it findeth repugnance

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in the parts of another loadstone, unlesse it be exactly situated in a right position. Besides, iron seemeth to be compared to a loadstone, like as a more humid body to a dryer of the same nature; and the difference of male and female sexes in animals do manifestly shew the great appetence of conjunction between moisture and dryenesse, when they belong to bodies of the same species.

5. Another question is that great one; why a loadstone capped with steel, takes up more iron thē it would do if it were without that capping? Another conclusion like unto this, is that if by a loadstone you take up an iron, and by that iron a second iron, and then you pull away the second iron; the first iron (in some position) will leave the loadstone to stick unto the second iron, as long as the second iron is within the sphere of the loadstones activity; but if you remove the second out of that sphere, then the first iron remaining within it, though the other be out of it, will leave the second, and leap back to the loadstone. To the same purpose, is this other conclusion; that the greater the iron is, which is entirely within the compasse of the loadstones virtue, the more strongly the loadstone will be moved unto it; and the more forcibly it will stick to it.

Gilberts reason refuted touching a capped loadstone, that taketh up more iron then one not capped; and an iron impregnated that in some case draweth more strongly then the stone it self.

The reasons of all these three, we must give at once; for they hang all upon one string. And in my conceit neither Gilbert nor Galileo have hit upon the right. As for Gilbert; he thinketh that in iron there is originally the virtue of the loadstone; but that it is as it were asleep untill by the touch of the loadstone it be awaked and set on work: and therefore the virtue of both joyned together, is greater then the virtue of the loadstone alone.

But if this were the reason, the virtue of the iron would be greater in every regard, and not onely in sticking or in taking up: whereas himself confesseth, that a capped stone draweth no further then a naked stone, nor hardly so farre. Besides, it would continue its virtue out of the sphere of activity of the loadstone, which it doth not. Again, seeing that if you compare them severally, the virtue of the loadstone is greater, then the virtue of the iron; why should not the middle iron stick closer to the stone then to the further iron which must of necessity have lesse virtue?

6. Galileo yieldeth the cause of this effect, that when an iron toucheth

Galileus his opinion touching the former effects refuted.

toucheth an iron there are more parts which touch one another, then when a loadstone toucheth the iron: both because the loadstone hath generally much impurity in it, and therefore divers parts of it have no virtue; whereas iron, by being melted hath all its parts pure: and secondly, because iron can be smoothed and polished more then a loadstone can be: and therefore its superficies toucheth in a manner with all its parts; whereas divers parts of the stones superficies cannot touch, by reason of its ruggednesse.

And he confirmeth his opinion by experience: for if you put the head of a needle to a bare stone, and the point of it to an iron; and then pluck away the iron; the needle will leave the iron and stick to the stone: but if you turn the needle the other way, it will leave the stone and stick to the iron. Out of which he inferreth that it is the multitude of parts, which causeth the close and strong sticking. And it seemeth he found the same in the capping of his loadstones: for he used flat irons for that purpose; which by their whole plane did take up other irons: whereas Gilbert capped his with convex irons; which not applying themselves to other iron, so strongly or with so many parts as Galileo's did, would not by much take up so great weights as his.

Nevertheless, it seemeth not to me that his answer is sufficient, or that his reasons convince; for we are to consider that the virtue wch he putteth in the iron must (according to his own supposition) proceed from the loadstone: and then, what importeth it, whether the superficies of the iron which toucheth another iron, be so exactly plain or no? Or that the parts of it be more solid then the parts of the stone? For all this conduceth nothing to make the virtue greater then it was: since no more virtue can go from one iron to the other, then goeth from the loadstone to the first iron: and if this virtue cannot tie the first iron to the loadstone, it cannot proceed out of this virtue that the second iron be tied to the first. Again, if a paper be put betwixt the cap and another iron, it doth not hinder the magneticall virtue from passing through it to the iron; but the virtue of taking up more weight then the naked stone was able to do, is thereby rendered quite useless. Therefore it is evident, that this virtue must be put in something else, and not in the application of the magneticall virtue.

And

And to examine his reasons particularly, it may very well fall out that whatsoever the cause be, the point of a needle may be too little to make an exact experience in; and therefore a new doctrine ought not lightly be grounded upon what appeareth in the application of that. And likewise, the greatnesse of the surfaces of the two irons may be a condition helpfull to the cause whatsoever it be: for greater and lesser are the common conditions of all bodies, and therefore do avail all kinds of corporeall causes; so that no one cause can be affirmed more then another, merely out of this, that great doth more, and little doth lesse.

7. The Authors solution to the former questions.

To come then to our own solution: I have considered how fire hath in a manner the same effect in iron, as the virtue of the loadstone hath by means of the cap: for I find that fire coming through iron red glowing hot, will burn more strongly, then if it should come immediately through the aire; as also we see that in pitcoal the fire is stronger then in charcole. And nevertheless, the fire will heat further if it come immediately from the source of it, then if it come through a red iron that burneth more violently where it toucheth; and likewise charcoal will heat further then pitcoal, that near hand burneth more fiercely. In the same manner, the loadstone will draw further without a cap then with one; but with a cap it sticketh faster then without one. Whence I see that it is not purely the virtue of the loadstone; but the virtue of it being in iron, which causeth this effect.

Now this modification may proceed either from the multitude of parts which come out of the loadstone, and are as it were stopped in the iron; and so the sphere of their activity becometh shorter, but stronger: or else from some quality of the iron joyned to the influence of the loadstone. The first seemeth not to give a good account of the effect; for why should a little paper take it away, seeing we are sure that it stoppeth not the passage of the loadstones influence? Again, the influence of the loadstone seemeth in its motion to be of the nature of light, which goeth in an insensible time as far as it can reach: and therefore were it multiplied in the iron, it would reach further then without it; and from it the virtue of the loadstone would begin a new sphere of activity. Therefore we more willingly cleave to the latter part of our determination.

And thereupon enquiring what quality there is in iron, whence this effect may follow; we find that it is distinguished from a loadstone, as a metall is from a stone. Now we know that metalls have generally more humidity then stones; and we have discourſed above, that humidity is the cauſe of sticking: eſpecially when it is little and denſe. Theſe qualities muſt needs be in the humidity of iron: which of all metalls is the moſt terreſtriall: and ſuch humidity as is able to stick to the influence of the loadstone, as it paſſeth through the body of the iron, muſt be exceeding ſubtil and ſmall; and it ſeemeth neceſſary that ſuch humidity ſhould stick to the influence of the loadstone, when it meeteth with it, conſidering that the influence is of it ſelf dry, and that the nature of iron is a kin to the loadstone: wherefore the humidity of the one, and the drought of the other will not fail of incorporating together. Now then, if two irons well poliſhed and plain, be united by ſuch a glew as reſulteth out of this compoſition, there is a manifeſt appearance of much reaſon for them to stick ſtrongly together. This is confirmed by the nature of Iron in very cold countreys & very cold weather: for the very humidity of the aire in times of froſt, will make upon iron, ſooner then upon other things, ſuch a sticking glew as will pull off the skin of a mans hand that toucheth it hard.

And by this diſcourſe, you will perceive that Galileo's arguments do confirm our opinion as well as his own; and that according to our doctrine, all circumſtances muſt fall out juſt as they do in his experiences. And the reaſon is clear why the interpoſition of another body hindereth the ſtrong sticking of iron to the cap of the loadstone; for it maketh the mediation between them greater, which we have ſhewed to be the generall reaſon why things are eaſily parted.

Let us then proceed to the reſolution of the other caſes propoſed. The ſecond is already reſolved: for if this glew be made of the influence of the loadstone, it cannot have force further then the loadstone it ſelf hath: and ſo farre it muſt have more force then the bare influence of the loadstone. Or rather the humidity of two irons maketh the glew of a fitter temper to hold, then that which is between a dry loadstone and iron; and the glew entereth better when both ſides are moiſt, then when onely one is ſo.

But

But this resolution though it be in part good, yet it doth not evacuate the whole difficulty, since the same case happeneth between a stronger and a weaker loadstone, as between a loadstone and iron: for the weaker loadstone, whilest it is within the sphere of activity of the greater loadstone, draweth away an iron set betwixt them, as well as a second iron doth. For the reason therefore of the little loadstones drawing away the iron, we may consider that the greater loadstone hath two effects upon the iron, which is betwixt it and a lesser loadstone, and a third effect upon the little loadstone it self. The first is that it impregnateth the iron, and giveth it a permanent vertue by which it worketh like a weak loadstone. The second is, that as it maketh the iron work towards the lesser loadstone by its permanent vertue; so also it accompanieth the steam that goeth from the iron towards the little loadstone with its own steam, which goeth the same way: so that both these steams do in company climbe up the steam of the little loadstone which meeteth them; and that steam climbeth up the enlarged one of both theirs together. The third effect which the greater loadstone worketh, is that it maketh the steam of the little loadstone become stronger by augmenting its innate vertue in some degree.

8. The reason why in the former case, a lesser loadstone doth draw the interjacent iron from the greater.

Now then, the going of the iron to either of the loadstones must follow the greater and quicker conjunction of the two meeting steams, and not the greatness of one alone. So that if the conjunction of the two steams between the iron and the little loadstone be greater and quicker then the conjunction of the two steams which meet between the greater loadstone and the iron, the iron must stick to the lesser loadstone. And this must happen more often then otherwise: for the steam which goeth from the iron to the greater loadstone, will for the most part be lesse then the steam which goeth from the lesser loadstone to the iron. And though the other steam be never so great, yet it cannot draw more then according to the proportion of its Antagonists coming from the iron. Wherefore seeing the two steams betwixt the iron and the little loadstone are more proportionable to one another, and the steam coming out of the little loadstone is notably greater then the steam going from the iron to the greater loadstone; the conjunction must be made for the most part to the little loadstone. And if this discourse doth not hold

in the former part of the Probleme, betwixt a ſecond iron and a loadſtone, it is ſupplyed by the former reaſon which we gave for that particular purpoſe.

The third caſe dependeth alſo of this ſolution; for the bigger an iron is, ſo many more parts it hath to ſuck up the influence of the loadſtone; and conſequently, doth it thereby the more greedily: and therefore the loadſtone muſt be carried to it more violently, and when they are joyned ſtick more ſtrongly.

9. Why the variation of a touched needle from the north, is greater, the nearer you go to the pole.

The ſixth queſtion is, Why the variations of the needle from the true north in the northern hemiſphere, are greater the nearer you go to the pole, and leſſer the nearer you approch to the equator. The reaſon whereof is plain in our doctrine; for conſidering that the magnetick virtue of the earth, ſtreameth from the north towards the equator; it followeth of neceſſity, that if there be two ſtreams of magnetick fluours iſſuing frō the north, one of them preciſely from the pole, and the other from a part of the earth near the pole; and that the ſtream coming from the point by ſide the pole, be but a little the ſtronger of the two; there will appear very little differencies in their ſeverall operations, after they have had a long ſpace to mingle their emanations together; which thereby do joyn and grow as it were into ſtream. Whereas the nearer you come to the pole, the more you will find them ſevered, and each of them working by its own virtue. And very near the point which cauſeth the variation, each ſtream worketh ſingly by it ſelf; and therefore here the point of variation muſt be maſter, and will carry the needle ſtrongly unto his courſe from the due north, if his ſtream be never ſo little more efficacious then the other.

Again, a line drawn from a point of the earth wide of the pole, to a point of the meridian near the equator, maketh a leſſe angle, then a line drawn from the ſame point of the earth, to a point of the ſame meridian nearer the pole: wherefore the variation being eſteemed by the quantities of the ſaid angles, it muſt needs be greater near the pole, then near the equator, though the cauſe be the ſame.

Which a little figure will preſently explicate. Let the point A, be the pole; and the line A B, the meridian; and the point B, the interſection of it, with a parallel near the equator; and the point C, the interſection of the meridian with the Tropick;

pick; and D, a point in the earth near the pole, unto which in the said intersection the needle tendeth, instead of looking directly to the pole, whereby it maketh variation from due north. I say then that the variation of a needle near the equator in the point B, looking upon the point D; cannot be so great and sensible, as the variation of a needle in the Tropick C, looking upon the same point; since the angle D B A, which is made by the variation of the first, is lesse then the angle D C A, which is made by the variation of the latter needle, nearer the pole.

But because it may happen, that in the parts near the equator, the variation may proceed from some piece of land, not much more northerly then where the needle is; but that beareth rather easterly or westerly from it; and yet Gilbers assertion goeth universally, when he saith the variations in southern regions are lesse then in northern ones; we must examine what may be the reason thereof. And presently the generation of the loadstone sheweth it plainly: for seeing the nature of the loadstone proceedeth out of this, that the sunne worketh more upon the torrid zone, then upon the poles; and that his too strong operation is contrary to the loadstone, as being of the nature of fire; it followeth evidently, that the lands of the torrid zone cannot be so magneticall (generally speaking) as the polar lands are; and by consequence, that a lesser land near the pole, will have a greater effect, then a larger continent near the equator: & likewise a land further off towards the pole, will work more strongly then a nearer land which lyeth towards the equator.

10. Whether in the same part of the world a touched needle may at one time vary more from the north, and at another time lesse.

The seventh question is, Whether in the same part of the world a touched needle may at one time vary more from the true north point, and at another time lesse? In which Gilbert was resolute for the negative part: but our latter Mathematicians are of another mind. Three experiences were made near London in three divers years. The two first 42 yeares distant from one another; and the third 12 yeares distant from the second. And by them it is found, that in the space of 54 years, the loadstone hath at London diminished his variation from the north, the quantity of 7 degrees and more. But so that in the latter years the diminution hath sensibly gone faster then in the former

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These observations peradventure are but little credited by strangers; but we who know the worth of the men that made them, cannot mistrust any notable errour in them: for they were very able mathematicians, and they made their observations with very great exactnesse; and there were severall judicious witnesses at the making of them; as may be seen in Master Gillebrand his print concerning this subject. And divers other particular persons do confirm the same; whose credit, though each single might peradventure be slighted, yet all in body make a great accession.

We must therefore cast about to find what may be the cause of an effect so paradox to the rest of the doctrine of the loadstone: for seeing that no one place, can stand otherwise to the north of the earth at one time then at another; how is it possible that the needle should receive any new variation, since all variation proceedeth out of the inequality of the earth? But when we consider that this effect proceedeth not out of the main body of the earth, but onely out of the bark of it; and that its bark may have divers tempers not as yet discovered unto us; and that out of the variety of these tempers, the influence of the earthy parts may be divers in respect of one certain place; it is not impossible but that such variation may be, especially in England: which Iland lying open to the north, by a great and vast ocean, may receive more particularly then other places the speciall influences and variation of the weather, that happen in those northeastern countreyes from whence this influence cometh unto us. If therefore there should be any course of weather, whose period were a hundred years (for example) or more or lesse and so might easily passe unmarked; this variation might grow out of such a course.

But in so obscure a thing, we have already hazarded to guesse too much. And upon the whole matter of the loadstone, it serveth our turn, if we have proved (as we conceive we have done fully) that its motions which appear so admirable, do not proceed from an occult quality; but that the causes of them may be reduced unto locall motion; and that all they may be performed by such corporeall instruments and means (though peradventure more intricately disposed) as all other effects are among bodies. Whose ordering and disposing and particular progresse, there

there is no reason to despair of finding out; would but men carefully apply themselves to that work, upon solid principles and with diligent experiences.

11. The whole doctrine of the loadstone summed up in short.

But because this matter hath been very long, and scatteringly diffused in many severall branches; peradventure it will not be displeasing to the Reader to see the whole nature of the loadstone summed up in short. Let him then cast his eyes upon one effect of it, that is very easie to be tried, and is acknowledged by all writers; though we have not as yet mentioned it. And it is, that a knife drawn from the pole of a loadstone towards the equator, if you hold the point towards the pole, it gaineth a respect to one of the poles: but contrariwise, if the point of the knife be held towards the equator, and be thrust the same way it was drawn before (that is, towards the equator) it gaineth a respect towards the contrary pole.

It is evident out of this experience, that the virtue of the loadstone is communicated by way of streams; and that in it, there are two contrary streams: for otherwise the motion of the knife this way or that way could not change the efficacity of the same parts of the loadstone. It is likewise evident, that these contrary streams do come from the contrary ends of the loadstone. As also that the virtues of them both are in every part of the stone. Likewise that one loadstone must of necessity turn certain parts of it self, to certain parts of another loadstone; nay that it must go and joyn to it, according to the laws of attraction which we have above delivered: and consequently, that they must turn their disagreeing parts away from one another; and so one loadstone seem to fly from another, if they be so applied that their disagreeing parts be kept still next to one another: for in this case, the disagreeing and the agreeing parts of the same loadstone, being in the same straight line; one loadstone seeking to draw his agreeing part near to that part of the other loadstone which agreeth with him, must of necessity turn away his disagreeing parts to give way unto his agreeing part to approach nearer.

And thus you see that the flying from one another of two ends of two loadstones, which are both of the same denomination (as for example, the two south ends, or the two north ends) doth not proceed from a pretended antipathy between those

those two ends, but from the attraction of the agreeing ends.

Furthermore, the earth, having to a loadstone the nature of a loadstone; it followeth that a loadstone must necessarily turn it self to the poles of the earth by the same laws. And consequently, must tend to the north, must vary from the north, must incline towards the center, and must be affected with all such accidents as we have deduced of the loadstone.

And lastly, seeing that iron is to a loadstone, a fit matter for it to impresse its nature in, and easily retaineth that magnetike virtue; the same effects that follow between two loadstones, must necessarily follow between a loadstone, and a piece of iron fitly proportionated in their degrees: excepting some little particularities, which proceed out of the naturalnesse of the magnetike virtue to a loadstone, more then to iron.

And thus you see the nature of the loadstone summed up in grosse; the particular joynts and causes whereof, you may find treated at large in the main discourse. Wherein we have governed our selves chiefly by the experiences that are recorded by Gilbert and Cabeus; to whom, we remit our reader for a more ample declaration of particulars.

## CHAP. XXIII.

*A description of the two sorts of living creatures; Plants, and Animals: and how they are framed in common to perform vitall motion.*

1. The connexion of the following Chapters with the precedent ones.

Hitherto we have endeavoured to follow by a continuall thrid, all such effects as we have met with among bodies, and to trace them in all their windings, and to drive them up to their very root and originall source: for the nature of our subject having been yet very common, hath not exceeded the compasse and power of our search and inquiry, to descend unto the chief circumstances and particulars belonging unto it. And indeed, many of the conveyances whereby the operations we have discoursed of, are performed, be so secret and abstruse, as they that look into them with lesse heedfulnesse and judgement then such a matter requireth, are too apt to impute them to mysterious causes above the reach of humane nature to comprehend, and to calumniate them of being wrought by occult and specifick qua-

qualities; whereof no more reason could be given, then if the effects were infused by Angelicall hands without assistance of inferiour bodies, which useth to be the last refuge of ignorant men, who not knowing what to say, and yet presuming to say something, do fall often upon such expressions, as neither themselves nor their hearers understand; and that if they be well scanned, do imply contradictions. Therefore we deemed it a kind of necessity to strain our selves to prosecute most of such effects, even to their notionall connexions with rarity and density. And the rather, because it hath not been our luck yet to meet with any that hath had the like designe, or hath done any considerable matter to ease our pains. Which cannot but make the readers journey somewhat tedious unto him to follow all our steps, by reason of the ruggednesse, and untrodenesse of the paths we have walked in.

But now the effects we shall henceforward meddle withall, do grow so particular, and do swarm into such a vast multitude of severall little joynts, and wreathy labyrinths of nature, as were impossible in so summary a treatise, as we intend, to deliver the causes of every one of them exactly; which would require both large discourses and abundance of experiences to acquit our selves as we ought of such a task. Nor is there a like need of doing it as formerly, for as much as concerneth our designe; since the causes of them are palpably materiall, and the admirable artifice of them consisteth onely in the Dedalean and wonderfull ingenious ordering and ranging them one with another.

We shall therefore intreat our Reader from this time forwards to expect onely the common sequele of those particular effects, out of the principles already laid. And when some shall occurre, that may peradventure seem at the first sight to be enacted immediately by a virtue spirituall, and that proceedeth indivisibly, in a different strain from the ordinary processes which we see in bodies and in bodily things (that is, by the virtues of rarity and density, working by locall motion) we hope he will be satisfied at our hands, if we lay down a methode, and trace out a course, whereby such events and operations may follow out of the principles we have laid. Though peadventure we shall not absolutely convince that every effect is done just as we set it down in every particular, and that it may not as well be done by some

some other disposing of parts under the same generall scope: for it is enough for our turn, if we shew that such effects may be performed by corporeall agents, working as other bodies do, without confining our selves to an exactnesse in every link of the long chain that must be wound up in the performance of them.

2. Concerning severall compositions of mixed bodies.

To come then to the matter; The next thing we are to employ our selves about, now that we have explicated the natures of those motions by means whereof bodies are made and destroyed; and in which they are to be considered chiefly as passive, whiles some exteriour agent working upon them causeth such alterations in them, and bringeth them to such passe as we see in the changes that are daily wrought among substances; is to take a survey of those motions which some bodies have, wherein they seem to be not so much patients as agents; and do contain within themselves the principle of their own motion; and have no relation to any outward object, more then to stirre up that principle of motion, and set it on work: which when it is once in act, hath as it were within the limits of its own kingdome, and severed from commerce with all other bodies whatsoever, many other subaltern motions over which it prefideth.

To which purpose we may consider, that among the compounded bodies whose natures we have explicated; there are some in whom the parts of different complexions are so small and so well mingled together, that they make a compound which to our sense seemeth to be all of it quite through of one homogeneous nature; and howsoever it be divided, each part retaineth the entire and complete nature of the whole. Others again there are, in which it is easie to discern that the whole is made up of severall great parts of very differing natures and tempers.

And of these there are two kinds: the one, of such as their differing parts seem to have no relation to one another, or correspondence together to perform any particular work, in which all of them are necessary; but rather they seem to be made what they are, by chance and by accident; and if one part be severed from another, each is an entire thing by it self, of the same nature as it was in the whole; and no harmony is destroyed by such division. As may be observed in some bodies digged out of mines, in which one may see lumps of metall, ore, stone,

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and glasse, and such different substances, in their severall distinct situations, perfectly compacted into one continuate body, which if you divide, the glasse remaineth what it was before, the Emerald is still an Emerald, the silver is good silver, and the like of the other substances; the causes of which may be easily deduced out of what we have formerly said. But there are other bodies in which this manifest and notable difference of parts, carrieth with it such a subordination of one of them unto another, as we cannot doubt but that nature made such engines (if so I may call them) by designe; and intended that this variety should be in one thing; whose unity and being what it is, should depend of the harmony of the severall differing parts, and should be destroyed by their separation. As we see in living creatures, whose particular parts and members being once severed, there is no longer a living creature to be found among them.

3. Two sorts of living creatures.

Now of this kind of bodies there are two sorts. The first is of those that seem to be one continuate substance, wherein we may observe one and the same constant progresse throughout, from the lowest unto the highest part of it; so that the operation of one part is not at all different from that of another: but the whole body seemeth to be the course and throughfare of one constant action, varying it self in diverse occasions and occurrences, according to the disposition of the subject.

The bodies of the second sort, have their parts so notably separated one from the other; and each of them have such a peculiar motion proper unto them, that one might conceive they were every one of them a complete distinct totall thing by it self, and that all of them were artificially tied together; were it not that the subordination of these parts to one another is so great, and the correspondence between them so strict, (the one not being able to subsist without the other, from whom he deriveth what is needfull for him; and again, being so usefull unto that other, and having its action and motion so fitting and necessary for it, as without it that other cannot be:) as plainly conviceth that the compound of all these severall parts must needs be one individuall thing.

4. An engine to expresse the first sort of living creatures.

I remember that when I travelled in Spain, I saw there two engines that in some sort do expresse the natures of these two kinds of bodies. The one at Toledo, the other at Segovia: both of

of them set on work by the current of the river, in which the foundation of their machine was laid. That at Toledo was to force up water a great height from the river Tagus to the Alcazar (the Kings pallace) that standeth upon a high steep hill or rock, almost perpendicular over the river. In the bottome there was an indented wheel, which turning round with the stream, gave motion at the same time to the whole engin; which consisted of a multitude of little troughs or square ladles set one over another in two parallel rows over against one another, from the bottome to the top, and upon two severall divided frames of timber. These troughs were closed at one end with a traverse board to retain the water from running out there; which end being bigger then the rest of the trough, made it somewhat like a ladle; and the rest of it seemed to be the handle with a channel in it, the little end of which channel or trough was open to let the water passe freely away. And these troughs were fastened by an axletree in the middle of them, to the frame of timber that went from the bottome up to the top: so that they could upon that center move at liberty, either the shut end downwards, or the open end; like the beam of a balance.

Now at a certain position of the root-wheel (if so I may call it) all one side of the machine sunk down a little lower towards the water, and the other was raised a little higher. Which motion was changed as soon as the ground-wheel had ended the remnant of his revolution: for then the side that was loweſt before, sprung up, and the other sunk down. And thus the two sides of the machine were like two legs that by turns trod the water; as in the vintage men presse grapes in a watte. Now the troughs that were fastened to the timber which descended, turned that part of them downwards which was like a box shut to hold the water: and consequently, the open end was up in the aire, like the arm of the balance unto which the lighteſt scale is fastened: and in the mean time, the troughs upon the ascending timber, were moved by a contrary motion; keeping their box ends aloft, and letting the open ends incline downwards: so that if any water were in them, it would let it run out; whereas the others retained any that came into them.

When you have made an image of this machine in your phantasie,

phantasie, consider what will follow out of its motion. You will perceive that when one leg sinketh down towards the water, that trough which is next to the superficies of it, putting down his box end, and dipping it a little in the water; must needs bring up as much as it can retain, when that leg ascendeth: wch when it is at its height, the trough moveth upon his own cēter; & the box end, which was lowest, becometh now highest, and so the water runneth out of it. Now the other leg descending at the same time; it falleth out that the trough on its side, which would be a step above that which hath the water in it, if they stood in equilibrity, becometh now a step lower then it: and is so placed, that the water which runneth out of that which is aloft, falleth into the head or box of it; which no sooner hath received it, but that leg on which it is fastned, springeth up, and the other descendeth: so that the water of the second leg, runneth now into the box of the first leg, that is next above that which first laded the water out of the river. And thus, the troughs of the two legs deliver their water by turnes from one side to the other; and at every remove, it getteth a step upwards, till it cometh to the toppe; whiles at every ascent and descent of the whole side, the lowest ladle or trough taketh new water from the river: which ladle full followeth immediately in its ascent, that which was taken up the time before. And thus, in a little while, all the troughs from the bottome to the top are full; unlesse there happen to be some failing in some ladle: and in that case the water breaketh out there; and all the ladles above that are dry.

5. Another engine by which may be expressed the second sort of living creatures.

The other engine, or rather multitude of severall engines, to perform sundry different operations, all conducing to one work (whereas, that of Toledo, is but one tenour of motion, from the first to the last;) is in the minte at Segovia. Which is so artificially made, that one part of it, distendeth an ingot of silver or gold into that breadth and thickneſse as is requisite to make coyn of. Which being done, it delivereth the plate it hath wrought, unto another that printeth the figure of the coyn upon it. And from thence it is turned over to another that cutteth it according to the print, into due shape and weight. And lastly, the severall pieces fall into a reserve, in another roome: where the officer, whose charge it is, findeth treasure ready coined; without any thing there, to informe him of the severall

different motions that the silver or the gold passed before they came to that state. But if he go on the other side of the wall, into the room where the other machines stand and are at work, he will then discern that every one of them, which considered by it self might seem a distinct complete engine, is but a serving part of the whole; whose office is, to make money: and that for this work, any one of them separated from the rest, ceaseth to be the part of a mint, and the whole is maimed and destroyed.

6. The two former engines and some other comparisons applied to expresse the two severall sorts of living creatures.

Now let us apply the consideration of these different kinds of engines, to the natures of the bodies we treat of. Which I doubt not, would fit much better, were they lively and exactly described. But it is so long since I saw them, and I was then so very young, that I retain but a confused and clowdy remembrance of them: especially of the mint at Segovia, in the which there are many more particulars then I have touched; as conveniency for refining the ore or metall; and then casting it into ingots; and driving them into rods, and such like: unto all which, there is little help of hands requisite, more then to apply the matter duly at the first. But what I have said of them, is enough to illustrate what I aim at: and though I should erre in the particulars, it is no great matter, for I intend not to deliver the history of them; but onely out of the remembrance of such notefull and artificiall masterpieces, to frame a modell in their phancies that shall reade this, of something like them; whereby they may with more ease, make a right conception of what we are handling.

Thus then; all sorts of plants, both great and small, may be compared to our first engine of the waterwork at Toledo, for in them all the motion we can discern, is of one part transmitting unto the next to it, the juice which it received from that immediatly before it: so that it hath one constant course from the root (which sucketh it from the earth) unto the top of the highest sprigge: in which if it should be intercepted and stopped by any maiming of the bark (the channell it ascendeth by) it would there break out and turn into drops, or gumme, or some such other substance as the nature of the plant requireth; and all that part of it unto which none of this juice can ascend would drie and wither and grow dead.

But sensible living creatures, we may fitly compare to the second machine of the mint at Segovia. For in them, though every part

part and member be as it were a complete thing of it self, yet every one requireth to be directed and put on in its motion by another; and they must all of them (though of very different natures and kinds of motion) conspire together to effect any thing that may be for the use and service of the whole. And thus we find in them perfectly the nature of a mover and a moveable; each of them moving differently from one another, and framing to themselves their own motions, in such sort as is most agreeable to their nature, when that part which setteth them on work hath stirred them up.

And now because these parts (the movers and the moved) are parts of one whole; we call the entire thing *automatum* or *se movens*; or a living creature. Which also may be fitly compared to a joyner, or a painter, or other craftsman, that had his tools so exactly fitted about him, as when he had occasion to do any thing in his trade, his tool for that action were already in the fittest position for it, to be made use of, so as without removing himself from the place where he might sit invironed with his tools, he might, by onely pulling of some little chords, either apply the matter to any remote tool, or any of his tools to the matter he would work upō, according as he findeth the one or the other more convenient for performāce of the action he intēdeth.

Whereas in the other, there is no variety of motions; but one and the same goeth quite through the body from one end of it to the other. And the passage of the moysture through it, from one part to another next (which is all the motion it hath) is in a manner but like the rising of water in a still, which by heat is made to creep up by the sides of the glasse; and from thence runneth through the nose of the limbeke, and falleth into the receiver. So that, if we will say that a plant liveth, or that the whole moveth it self, and every part moveth other; it is to be understood in a farre more imperfect manner, then when we speak of an animall: and the same words are attributed to both, in a kind of equivocall sense. But by the way I must note, that under the title of plants I include not zoophytes or plantanimals: that is such creatures as though they go not from place to place, and so cause a locall motion of their whole substance, yet in their parts, they have a distinct and articulate motion.

But to leave comparisons, and come to the proper nature of the

7. How plants are framed.

things: let us frame a conception, that not far under the superficies of the earth, there were gathered together divers parts of little mixed bodies, which in the whole summe were yet but little: and that this little masse had some excesse of fire in it, such as we see in wet hay, or in muste of wine, or in woort of beere: and that withall the drought of it were in so high a degree, as this heat should not find means (being too much compressed) to play his game: and that, lying there in the bosome of the earth, it should after some little time receive its expected and desired drink through the benevolence of the heaven; by which it being moistned, and thereby made more pliable, and tender and easie to be wrought upon, the little parts of fire should break loose; and they finding this moysture a fit subject to work upon, should drive it into all the parts of the little masse, and digesting it there should make the masse swel. Which action taking up long time for performance of it, in respect of the smal increase of bulk made in the masse by the swelling of it; could not be hindred by the pressing of the earth, though lying never so weightily upon it: according to the maxime we have above delivered, that any little force, be it never so little; is able to overcome any great resistance, be it never so powerfull; if the force do multiply the time it worketh in, sufficiently to equalise the proportions of the agent and the resistant.

This increase of bulk and swelling of the little masse, will of its own nature be towards all sides, by reason of the fire & heat that occasioneth it (whose motion is on every side, from the center to the circumference:) but it will be most efficacious upwards, towards the aire, because the resistance is least that way; both by reason of the little thicknes of the earth over it; as also by reason that the upper part of the earth lieth very loose and is exceeding porous, through the continuall operation of the sunne and falling of rain upon it. It cannot choose therefore but mount to the aire; and the same cause that maketh it do so, presseth at the same time the lower parts of the masse, downwards. But what ascendeth to the aire, must be of the hotter and more moist parts of the fermenting masse; and what goeth downwards must be of his harder and drier parts proportionate to the contrary motions of fire and of earth, which predominate in these two kinds of parts. Now this that is pushed upwards, coming

coming above ground, and being there exposed to sunne and wind, contracteth thereby a hard and rough skinne on its outside; but within is more tender; in this sort it defendeth it self from outward injuries of weather whiles it mounteth: and by thrusting other parts down into the earth, it holdeth it self stedfast, that although the wind may shake it, yet it cannot overthrow it. The greater this plant groweth, the more juice is dayly accrewed unto it, and the heat is encreased; and consequently, the greater abundance of humours is continually sent up. Which when it beginneth to clogge at the top, new humour pressing upwards, forceth a breach in the skinne; and so a new piece, like the main stemme, is thrust out and beginneth on the sides, which we call a branch. Thus is our plant amplified, till nature not being able still to breed such strong issues, falleth to works of lesse labour, and pusheth forth the most elaborate part of the plants juice into more tender substances: but especially, at the ends of the branches; where abundant humour, but at the first not well concocted, groweth into the shape of a button; and more and better concocted humour succeeding, it groweth softer and softer (the sunne drawing the subtilleſt parts outwards) excepting what the coldnesse of the aire and the roughnesse of the wind do harden into an outward skin. So then the next parts to the the skin are tender; but the very middle of this button must be hard and dry, by reason that the sun from without, and the naturall heat within, drawing and driving out the moysture and extending it from the center, must needs leave the more earthy parts much shrunk up and hardned by their evaporating out from them: which hardning, being an effect of fire within and without, that baketh this hard substance, incorporateth much of it self with it, as we have formerly declared in the making of salt by force of fire. This button, thus dilated, and brought to this passe, we call the fruit of the plant: whose harder part encloseth oftentimes another not so hard as dry. The reason whereof is because the outward hardnesse permitteth no moysture to soake in any abundance through it; and then, that which is enclosed in it, must needs be much dried; though not so much, but that it still retaineth the common nature of the plant. This drought maketh these inner parts to be like a kind of dust; or at the least, such as

may be easily dried into dust, when they are bruſed out of the husk that incloſeth them. And in every parcell of this dust, the nature of the whole reſideth; as it were contracted into a ſmall quantity; for the juice which was first in the button, and had paſſed from the root through the manifold varieties of the divers parts of the plant, and had ſuffered much concoction, partly from the ſun and partly from the inward heat impriſoned in that harder part of the fruit; is by theſe paſſages, ſtrainings and concoctions, become at the length to be like a tincture extracted out of the whole plant; and is at the laſt dried up into a kind of magiſtery. This we call the ſeed; which is of a fit nature, by being buried in the earth and diſſolved with humour, to renew and reciprocate the operation we have thus deſcribed. And thus, you have the formation of a plant.

8. How ſenſitive creatures are formed.

But a ſenſitive creature, being compared to a plant, as a plant is to a mixed body; you cannot but conceive that he muſt be compounded as it were of many plants, in like ſort as a plant is of many mixed bodies. But ſo, that all the plants which concur to make one animall, are of one kind of nature and cognation: and beſides, the matter, of which ſuch diverſity is to be made, muſt of neceſſity be more humid and figurable, then that of an ordinary plant: and the artificer which worketh and mouldeth it, muſt be more active. Wherefore we muſt ſuppoſe that the maſſe, of which an animall is to be made, muſt be actually liquid: and the fire that worketh upon it, muſt be ſo powerfull that of its own nature, it may be able to convert this liquid matter into ſuch breaths and ſteams, as we ſee do uſe to riſe from water, when the ſun or fire worketh upon it. Yet if the maſſe were altogether as liquid as water, it would vaniſh away by heat boyling it, and be dried up: therefore it muſt be of ſuch a convenient temper, that although in ſome of its parts it be fluid and apt to run; yet by others it muſt be held together; as we ſee that unctuous things for the moſt part are; which will ſwell by heat, but not fly away.

So then if we imagine a great heat to be impriſoned in ſuch a liquor; and that it ſeeketh by boyling, to break out; but that the ſolidneſſe and viſcouſneſſe of the ſubſtance will not permit it to evaporate: it cannot chuſe but comport it ſelf in ſome ſuch ſort as we ſee butter or oyle in a frying pan over the fire, when

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it riseth in bubbles: but much more efficaciously; for their body is not strong enough to keep in the heat: and therefore those bubbles fall again; whereas if it were, those bubbles would rise higher and higher, and stretch themselves longer and longer (as when the soap-boylers do boyl a strong unctuous lye into soap;) and every one of them would be as it were a little brook, whereof the channell would be the enclosing substance; and the inward smoke that extendeth it, might be compared to the water of it: as when a glasse is blown out by fire and aire into a long figure.

Now we may remember, how we have said, where we treated of the production and resolution of mixed bodies, that there are two sorts of liquid substantiall parts, which by the operation of fire are sent out of the body it worketh upon; the watery, and the oyly parts. For though there appear sometimes some very subtile and ethereall parts of a third kind (which are the aquæ ardentes, or burning spirits;) yet in such a close distilling of circulation as this is, they are not severed by themselves, but do accompany the rest; and especially the watery parts: which are of a nature, that the rising Ethereall spirits easily mingle with, and extend themselves in it; whereby the water becometh more efficacious, and the spirits lesse fugitive.

Of these liquid parts which the fire sendeth away, the watery ones are the first, as being the easiest to be raised: the oyly parts rise more difficultly, and therefore do come last. And in the same manner it happeneth in this emission of brooks, the watery and oyly steams will each of them fly into different reserves: and if there arrive unto them abundance of their own quality, each of them must make a substance of its own nature by settling in a convenient place, and by due concoction. Which substance after it is made and confirmed, if more humidity and heat do presse it, will again break forth into other little channels. But when the watery and oyly parts are boyled away, there remain yet behinde other more solid and fixed parts, and more strongly incorporated with fire then either of these: which yet cannot drie up into a fiery salt, because a continuall accession of humour keepeth them alwayes flowing: and so they become like a couldron of boyling fire. Which must propagate it self as wide as either of the others; since the

activity of it must needs be greater then theirs (as being the source of motion unto them) and that there wanteth not humidity for it to extend it self by.

And thus you see three roots of three divers plants, all in the same plant, proceeding by naturall resolution from one primitive source. Whereof that which is most watry, is fittest to fabricate the body and common outside of the triformed plant; since water is the most figurable principle that is in nature, and the most susceptible of multiplication; and by its cold is easiest to be hardened, and therefore fittest to resist the injuries of enemy bodies that may infest it. The oily parts are fittest for the continuance and solidity of the plant: for we see that viscuosity and oylinesse hold together the parts where they abound; and they are slowly wasted by fire, but do conserve and are an aliment to the fire that consumeth them. The parts of the third kind are fittest for the conservation of heat: which though in them it be too violent; yet it is necessary for working upon other parts, and for maintaining a due temper in them.

And thus we have armed our plant with three sorts of rivers or brooks to run through him, with as many different streams; the one of a gentle balsamike oyl; an other, of streaming fire; and the third, of a connaturall and cooler water to irrigate and temper him. The streams of water, (as we have said) must run through the whole fabrick of this triformed plant: and because it is not a simple water, but warm in a good degree, and as it were a middle substance betwixt water and aire (by reason of the ardent volatile spirit that is with it) it is of a fit nature to swell, as aire doth; and yet withall to resist violence in a convenient degree, as water doth. Therefore if from its source nature sendeth abundance into any one part; that part must swell and grow thicker and shorter; and so must be contracted that way which nature hath ordered it. Whence we perceive a means by which nature may draw any part of the outward fabrick, which way soever she is pleased by set instruments for such an effect. But when there is no motion, or but little in these pipes, the standing stream that is in a very little, though long channel, must needs be troubled in its whole body, if any one part of it be pressed upon, so as to receive thereby any impression: and there-

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fore whatsoever is done upon it, though at the very furthest end of it, maketh a commotion and sendeth an impression up to its very source. Which appearing by our former discourse to be the origine of particular and occasionall motions; it is obvious to conceive how it is apt to be moved and wrought by such an impression to set on foot the beginning of any motion; which by natures providence is convenient for the plant, when such an impression is made upon it.

And thus you see this plant hath the virtue both of sense or feeling; that is, of being moved and affected by extern objects, lightly striking upon it; as also of moving it self, to or from such an object; according as nature shall have ordained. Which in summe is; that this plant is a sensitive creature, composed of three sources, the heart, the brain, and the liver: whose off-springs are the arteries, the nerves, and the veins; which are filled with vitall spirits, with animal spirits, and with bloud: and by these the animal is heated, nourished, and made partaker of sense and motion.

Novv referring the particular motions of living creatures, to another time: vve may observe, that both kinds of them, as vvell vegetables as animals do agree in the nature of sustaining themselves in the three common actions, of generation, nutrition, and augmentation; vvhich are the beginning, the progresse, and the conserving of life. Unto vvhich three vve may adde the not so much action as passion of death, and of sicknes or decay, vvhich is the vvay to death.

## CHAP. XXIIII.

### *A more particular survey of the generation of Animals, in which is discovered what part of the animal is first generated.*

1. The opinion that the seed containeth formally every part of the parent.

TO begin then with examining how living creatures are ingendered: our main question shall be, Whether they be framed entirely at once; or successively, one part after an other? And if this latter way, which part first? Upon the discussion of which, all that concerneth generation will be explicated, as much as concerneth our purpose in hand. To deduce this from its origine, we may remember how our Masters tell us, that when any living creature is passed the heat of its augmentation or grow-

growing; the superfluous nourishment settleth it self in some appointed place of the body to serve for the production of some other. Now it is evident that this superfluity cometh from all parts of the body, and may be said to contain in it after some sort the perfection of the whole living creature. Be it how it will, it is manifest that the living creature is made of this superfluous moysture of the parent: which, according to the opinion of some, being compounded of severall parts derived from the severall limbs of the parent; those parts when they come to be fermented in convenient heat and moysture, do take their posture and situation, according to the posture and disposition of parts that the living creature had from whence they issued: and then they growing daily greater and solider, (the effects of moysture and of heat;) do at the length become such a creature as that was, from whence they had their origine.

Which an accident that I remember, seemeth much to confirm. It was of a cat that had its tail cut off when it was very young: which cat happening afterwards to have young ones, half the kitlings proved without tails, and the other half had them in an ordinary manner; as if nature could supply but one partners side, not on both. And another particular that I saw when I was at Argiers, maketh to this purpose, which was of a woman that having two thumbs upon the left hand; foure daughters that she had did all resemble her in the same accident, and so did a little child, a girl of her eldest daughters; but none of her sonnes. Whiles I was there I had a particular curiosity to see them all: and though it be not easily permitted unto Christians to speak familiarly with Mahometan women; yet the condition I was in there, and the civility of the Bassha, gave me the oportunity of full view and discourse with them: and the old woman told me, that her mother and grandmother had been in the same manner. But for them it resteth upon her credit: the others I saw my self.

2. The former opinion rejected.

But the opinion which these accidents seem to support, though at the first view it seemeth smoothly to satisfie our inquiry, and fairly to compasse the making of a living creature: yet looking further into it, we shall find it fall exceeding short of its promising; and meet with such difficulties, as it cannot overcome. For first, let us cast about how this compound of severall parts, that

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serves for the generation of a new living creature, can be gathered from every part & member of the parent; so to carry with it in little the complete nature of it. The meaning hereof must be, that this superfluous aliment, either passeth through all and every little part and particle of the parents body, and in its passage receiveth something from them: or else, that it receiveth onely from all similar and great parts.

The former seemeth impossible, for how can one imagine that such juyce should circulate the whole body of an animall, and visit every atome of it, and retire to the reserve where it is kept for generation; and no part of it remain absolutely behind, sticking to the flesh or bones that it bedeweth; but that still some part returneth back from every part of the animal? Besides, consider how those parts that are most remote from the channels which convey this juyce; when they are fuller of nourishment then they need, the juyce which overfloweth from them, cometh to the next part, and settling there and serving it for its due nourishment, driveth back into the channell, that which was betwixt the channell and it self; so that here there is no return at all from some of the remote parts; and much of that juyce which is rejected, never went far from the channell it self. We may therefore safely conclude, that it is impossible every little part of the whole body should remit something impregnated and imbued with the nature of it.

But then you may peradventure say, that every similar part doth. If so, I would ask, how it is possible that by fermentation onely, every part should regularly go to a determinate place, to make that kind of animal; in which every similar part is diffused to so great an extent? How should the nature of flesh here become broad, there round, and take just the figure of the part it is to cover? How should a bone here be hollow, there be blady, and in another part take the form of a rib, and those many figures which we see of bones? And the like we might ask of every other similar part, as of the veins and the rest. Again, seeing it must of necessity happen, that at one time more is remitted from one part then from another; how cometh it to passe, that in the collection the due proportion of nature is so punctually observed? Shall we say that this is done by some cunning artificer, whose work it is to set all these parts in their due posture; which

Aristotle

Aristotle attributeth to the seed of the male? But this is impossible; for all this diversity of work is to be done at one time, and in the same occasions: which can no more be effected by one agent, then multiplicity can immediately proceed from unity.

But besides that there can be no agent to dispose of the parts when they are gathered; it is evident that a sensitive creature may be made without any such gathering of parts beforehand from an other of the same kind: for else, how could vermine breed out of living bodies, or out of corruption? How could rats come to fill ships, into which never any were brought? How could frogs be ingendred in the aire? Eels of dewy turfs, or of mud? Toads of ducks? Fish of herns? and the like. To the same purpose; when one species or kind of animal is changed into another; as when a caterpiller or a silk-worm becometh a flie; it is manifest that there can be no such precedent collection of parts.

3. The Authours opinion of this question.

And therefore there is no remedy but we must seek out some other means and course of generation, then this. Unto which we may be lead, by considering how a living creature is nourished and augmented: for why should not the parts be made in generation of a matter like to that which maketh them in nutrition? If they be augmented by one kind of juyce that after severall changes turneth at the length into flesh and bone; and into every sort of mixed body or similar part, whereof the sensitive creature is compounded; and that joyneth it self to what it findeth already made, why should not the same juyce with the same progresse of heat and moisture, and other due temperaments, be converted at the first into flesh and bone, though none be formerly there to joyn it self unto?

Let us then conclude that the juyce which serveth for nourishment of the animal, being more then is requisite for that service; the superfluous part of it is drained from the rest, and is reserved in a place fit for it: where by little and little through digestion, it gaineth strength, and vigour, and spirits to it self, and becometh an homogeneall body, such as other simple compounds are; which by other degrees of heat and moisture, is changed into an other kind of substance: and that again by other temperaments into another. And thus, by the course of nature, and by passing successively many degrees of temper, and by receiving a totall change

change in every one of them; at the length an animal is made of such juyce as afterwards serveth to nourish him.

4. Their opinion refuted, who hold that every thing containeth formally all things.

But to bring this to passe a shorter way, and with greater facility; some have been of opinion, that all similar things of whatsoever substance, are undiscernably mixed in every thing that is: and that to the making of any body out of any thing, there is no more required but to gather together those parts which are of that kind, and to separate, and cast away from them, all those which are of a nature differing from them.

But this speculation will appear a very aiery & needlesse one, if we consider into how many severall substances the same species of a thing may be immediately changed; or rather how many severall substances may be encreased immediately from severall equall individuals of the same thing; and then take an account how much of each individuall is gone into each substance which it hath so increased. For if we summe up the quantities that in the severall substances are thereby encreased; we shall find that they do very much exceed the whole quantity of any one of the individuals: which should not be if the supposition were true; for every individuall should be but one totall made up of the severall different similar parts, which encrease the severall substances, that extract out of them what is of their own nature.

This will be better understood by an example: suppose that a man, a horse, a cow, a sheep, and 500. more severall species of living creatures, should make a meal of letuce: to avoid all perplexity in conceiving the argument, let us allow that every one did eat a pound; and let us conceive another pound of this herb to be burned; as much to be putrified under a cabage root; and the like under 500 plants more of diverse species. Then cast how much of every pound of letuce is turned into the substances that are made of them, or that are encreased by them; as, how much ashes one pound hath made; how much water hath been distilled out of another pound; how much a man hath been encreased by a third; how much a horse by a fourth; how much earth by the putrefaction of a fifth pound; how much a cabage hath been encreased by a sixth: and so go over all the pounds that have been turned into substances of different specieses (which may be multiplied as much as you please.) And when you have summed up

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all these severall quantities, you will find them far to exceed the quantity of one pound: which it would not do, if every pound of letuce were made up of severall different similar parts actually in it, that are extracted by different substances of the natures of those parts; and that no substance could be encreased by it, unlesse parts of its nature were originally in the letuce.

5. The Authours opinion concerning the generation of animals declared and confirmed.

On the other side, if we but cast our eye back upon the principles we have laid, where we discourse of the composition of bodies; we shall discern how this work of changing one thing into another, either in nutrition, in augmentation, or in generation; will appear not onely possible, but easie to be effected. For out of them it is made evident how the severall varieties of solid and liquid bodies; all differences of naturall qualities, all consistences, and whatsoever else belongeth to similar bodies; resulteth out of the pure and single mixture of rarity and density; so that to make all such varieties as are necessary, there is no need of mingling, or of separating any other kinds of parts: but onely an art or power to mingle in due manner, plain, rare and dense bodies one with an other. Which very action and none other (but with excellent method and order, such as becometh the great Architect that hath designed it) is performed in the generation of a living creature: which is made of a substance at the first, farre unlike what it afterwards grovveth to be.

If we look upon this change in grosse, and consider but the two extremes (to wit, the first substance, of which a living creature is made; and it self in its full perfection) I confesse, it may well seem incredible how so excellent a creature can derive its origine from so mean a principle, and so far remote and differing from what it groweth to be. But if we examine it in retail, and go along anatomising it in every step and degree that it changeth by; we shall find that every immediate change is so near, and so palpably to be made by the concurrent causes of the matter prepared; as we must conclude it cannot possiby become any other thing then just what it doth become.

Take a bean, or any other seed, and put it into the earth, and let water fall upon it; can it then choose but that the bean must swell? The bean swelling, can it choose but break the skin? The skin broken, can it choose (by reason of the heat that is in it)

but

but push out more matter, and do that action which we may call germinating? Can these germs choose but pierce the earth in small strings, as they are able to make their way? Can these strings choose but be hardened, by the compression of the earth, and by their own nature, they being the heaviest parts of the fermented bean? And can all this be any thing else but a root? Afterwards the heat that is in the root, mingling it self with more moisture, and according to its nature, springing upwards; will it not follow necessarily, that a tender green substance (which we call a bud, or leaf) must appear a little above the earth; since tenderness, greenness, and ascent, are the effects of those two principles, heat and moisture? And must not this green substance change from what it was at the first, by the sunne and aire working upon it, as it groweth higher; till at the length it hardeneth into a stalk? All this while, the heat in the root sublimeth up more moisture, which maketh the stalk at the first grow rank and encrease in length. But when the more volatile part of that warm juice, is sufficiently depured and sublimed, will it not attempt to thrust it self out beyond the stalk with much vigour and smartnesse? And as soon as it meeteth with the cold aire in its eruption, will it not be stopped and thickned? And new parts flocking still from the root, must they not clog that issue, and grow into a button, which will be a bud? This bud being hardened at the sides, by the same causes which hardened the stalk, and all the while the inward heat still streaming up, and not enduring to be long encloſed, (especially when by its being stopped, it multiplyeth it self) will it not follow necessarily that the tender bud must cleave, and give way to that spirituall juice; which being purer then the rest (through its great sublimation) sheweth it self in a purer and nobler substance then any that is yet made; and so becometh a flower? From hence, if we proceed as we have begun, and do weigh all circumstances; we shall see evidently, that another substance must needs succeed the flower, which must be hollow and contain a fruit in it: and that this fruit must grow bigger and harder. And so, to the last period of the generation of new beans.

Thus by drawing the thrid carefully along through your fingers, and staying at every knot to examine how it is tyed; you see that this difficult progresse of the generation of living creatures,

creatures, is obvious enough to be comprehended; and that the steps of it are possible to be set down; if one would but take the pains and afford the time that is necessary (lesse then that Philosopher, who for so many years gave himself wholly up to the single observing of the nature of bees) to note diligently all the circumstances in every change of it. In every one of which the thing that was, becometh absolutely a new thing; and is endewed with new properties and qualities different from those it had before, as Physitians from their certain experience do assure us. And yet every change is such, as in the ordinary and generall course of nature (wherein nothing is to be considered, but the necessary effects following out of such Agents working upon such patients, in such circumstances) it is impossible that any other thing should be made of the precedent, but that which is immediately subsequent unto it.

Now if all this orderly succession of mutations be necessarily made in a bean, by force of sundry circumstances and externall accidents; why may it not be conceived that the like is also done in sensible creatures; but in a more perfect manner, they being perfecter substances? Surely the progresse we have set down is much more reasonable, then to conceive that in the meal of the bean are contained in little, severall similar substances; as, of a a root, of a leaf, a stalk, a flower, a cod, fruit, and the rest; and that every one of these, being from the first still the same that they shall be afterwards, do but suck in more moisture from the earth, to swell and enlarge themselves in quantity. Or, that in the seed of the male, there is already in act, the substance of flesh, of bone, of sinews, of veins, and the rest of those severall similar parts which are found in the body of an animall; and that they are but extended to their due magnitude, by the humidity drawn from the mother, without receiving any substantiall mutation from what they were originally in the seed.

Let us then confidently conclude, that all generation is made of a fitting, but remote, homogeneall compounded substance: upon which, outward Agents, working in the due course of nature, do change it into another substance, quite different from the first, and do make it lesse homogeneall then the first was. And other circumstances & agents do change this second into a third; that third, into a fourth; and so onwards, by successive mutations (that

(that still make every new thing become lesse homogeneall, then the former was, according to the nature of heat, mingling more and more different bodies together) untill that substance be produced, which we consider in the period of all these mutations.

And this is evident out of many experiences: as for example in trees; the bark which is opposed to the north wind, is harder and thicker then the contrary side which is opposed to the south, and a great difference will appear in the grain of the wood; even so much, that skilfull people will by feeling and seeing a round piece of the wood after the tree is felled, tell you in what situation it grew, and which way each side of that piece looked. And Josephus Acosta writeth of a tree in America, that on the one side being situated towards great hills, and on the other being exposed to the hot sunne; the one half of it flourisheth at one time of the year, and the other half at the opposite season. And some such like may be the cause of the strange effects we sometimes see of trees, flourishing or bearing leafs at an unseasonable time of the year; as in particular, in the famous oke in the New-forest, and in some others in our Island: in which peradventure the soyl they grow in, may do the same effect, as the winds and sunne did in the tree that Acosta maketh mention of. For we dayly see how some soils are so powerfull over some kind of corn, that they will change the very nature of it; so that, you shall reap oats or rie, after you have sown wheat there.

Which sheweth evidently that since the outward circumstances can make the parts or the whole of any substance, become different from what they were at the first; generation is not made by aggregation of like parts to presuppoled like ones: nor by a specificall worker within; but by the compounding of a seminary matter, with the juice which accrueth to it from without, and with the steams of circumstant bodies; which by an ordinary course of nature, are regularly imbibed in it by degrees; and which at every degree, do change it into a different thing, such an one as is capable to result out of the present compound, (as we have said before) untill it arrive to its full perfection.

Which yet is not the utmost period of natures changes; for 6.

That one substance is changed into another.

from that, for example, from corn or an animal, it carryeth it on (still changing it) to be meal or a cadaver: from thence to be bread or durt: after that to be bloud or grasse. And so, still turning about her wheel (which suffereth nothing to remain long in the state it is in) she changeth all substances from one into another. And by reiterated revolutions, maketh in time every thing of every thing: as when of mud she maketh tadpoles, and frogs of them; and afterwards, mud again of the frogs: or when she runneth a like progresse; from earth to worms; and from them, to flies; and the like: so changing one animall into such another; as in the next precedent step, the matter in those circumstances is capable of being changed into; or rather (to say better) must necessarily be changed into.

To confirm this by experience; I have been assured, by one who was very exact in noting such things; that he once observed in Spain, in the spring season, how a stick lying in a moist place, grew in tract of time to be most of it a rotten durty matter; and that at the durty end of the stick, there began a rude head to be formed of it by little and little; and after a while some little legs began to discover themselves near this unpolished head, which dayly grew more and more distinctly shaped. And then, for a pretty while (for it was in a place where he had the conveniencie to observe dayly the progresse of it, and no body came near to stirre it in the whole course of it) he could discern where it ceased to be a body of a living creature, and where it began to be dead stick or dirt; all in one continuate quantity or body. But every day the body grew longer and longer, and more legs appeared, till at the length, when he saw the animall almost finished, and near separating it self from the rest of the stick, he stayed then by it, and saw it creep away in a caterpillar, leaving the stick and dirt, as much wanting of its first length, as the worms body took up. Peradventure the greatest part of such creatures maketh their way by such steps into the world. But to be able to observe their progresse thus distinctly as this Gentleman did, happeneth not frequently.

7. Concerning the hatching of

Therefore, to satisfie our selves herein it were well we made our remarks in some creatures that might be continually in our power

power to observe in them the course of nature every day and houre. Sir John Heydon, the Lieutenant of his Majesties ordinance (that generous and knowing Gentleman; and consummate souldier both in theory and practise) was the first that instructed me how to do this, by means of a furnace so made as to imitate the warmth of a sitting henne. In which you may lay severall egges to hatch; and by breaking them at severall ages you may distinctly observe every hourely mutation in them, if you please. The first will be, that on one side you shall find a great resplendent clearnesse in the white. After a while, a little spot of red matter like bloud, will appear in the midst of that clearnesse fastened to the yolk: which will have a motion of opening and shutting; so as sometimes you will see it, and straight again it will vanish from your sight; and indeed at the first it is so little, that you cannot see it, but by the motion of it; for at every pulse, as it openeth, you may see it, and immediately again, it shutteth in such sort, as it is not to be discerned. From this red speck, after a while there will stream out, a number of little (almost imperceptible) red veins. At the end of some of which, in time there will be gathered together, a knot of matter which by little and little will take the form of a head; and you will ere long begin to discern eyes and a beak in it. All this while the first red spot of bloud, groweth bigger and solider: till at the length, it becometh a fleshy substance; and by its figure, may easily be discerned to be the heart: which as yet hath no other enclosure but the substance of the egge. But by little and little the rest of the body of an animal is framed out of those red veins which stream out all about from the heart. And in processe of time, that body incloseth the heart within it by the chest, which groweth over on both sides, and in the end meeteth, and closeth it self fast together. After which this little creature soon filleth the shell, by converting into severall parts of it self all the substance of the egge. And then growing weary of so straight an habitation, it breaketh prison, and cometh out, a perfectly formed chicken.

chickens, and the generation of other animals.

In like manner: in other creatures; which in latine are called *Vivipara* (because their young ones are quick in their mothers wombe) we have, by the relation of that learned and exact

act searcher into nature, Doctour Harvey: that the seed of the male after his accoupling with the female, doth not remain in her wombe in any sensible bulk: but (as it seemeth) evaporateth and incorporateth it self, either into the body of the wombe, or rather into some more interior part, as into the seminary vessels. Which being a solid substance, much resembling the nature of the females seed, is likely to suck up, by the mediation of the females seed, the males seed incorporated with it, and by incorporation, turned as it were into a vapour: in such sort as we have formerly explicated how the body of a scorpion or viper draweth the poyson out of a wound. And after a certain time (Doctour Harvey noted the space of six weeks or two months in does or hindes) these seeds distill again into the wombe; and by little and little do clarifie in the midst, and a little red speck appeareth in the center of the bright clearnesse: as we said before of the egge.

8. From whence it happeneth that the deficiences, or excrescences of the parents body are often seen in their children.

But we should be too blame to leave our Reader without clearing that difficulty, which cannot choose but have sprung up in his thoughts, by occasion of the relations we made at the entrance into this point concerning the cat whose kitlings were half with tails, and half without: and the womans daughters at Argiers, that had as well as their mother excrescences upon their left thumbs, imitating another lesser thumb: and the like effects whensoever they happen, which they do frequently enough.

Let him therefore remember, how we have determined that generation is made of the bloud, which being dispersed into all the parts of the body to irrigate every one of them; and to convey fitting spirits into them from their source or shop where they are forged; so much of it as is superabundant to the nourishing of those parts is sent back again to the heart to recover the warmth and spirits it hath lost by so long a journey. By which perpetuall course of a continued circulation, it is evident that the bloud in running thus through all the parts of the body must needs receive some particular concoction or impression from every one of them. And by consequence, if there be any specificall virtue in one part which is not in another, then the bloud returning from

from thence must be endued with the virtue of that part. And the purest part of this bloud, being extracted like a quintessence out of the whole masse, is reserved in convenient receptacles or vessels till there be use of it: and is the matter or seed, of which a new animall is to be made; in whom, will appear the effect of all the specificall virtues drawn by the bloud in its iterated courses, by its circular motion, through all the severall parts of the parents body.

Whence it followeth, that if any part be wanting in the body whereof this seed is made, or be superabundant in it; whose virtue is not in the rest of the body, or whose superabundance is not allaid by the rest of the body; the virtue of that part, cannot be in the bloud, or will be too strong in the bloud, and by consequence, it cannot be at all, or it will be too much in the seed. And the effect proceeding from the seed, that is, the young animal will come into the world savouring of that origine; unlesse the mothers seed, do supply or temper, what the fathers was defective or superabundant in; or contrariwise the fathers do correct the errours of the mothers.

9. The difference between the Authours opinion, and the former one.

But peradventure the Reader will tell us, that such a specificall virtue cannot be gotten by concoction of the bloud, or by any pretended impression in it; unlesse some little particles of the nourished part do remain in the bloud, and return back with it, according to that maxime of Geber, *Quod non ingreditur, non immutat*: no body can change another unlesse it enter into it, and mixing it self with it do become one with it. And that so in effect, by this explication we fall back into the opinion which we rejected.

To this I answer, that the difference is very great between that opinion and ours; as will appear evidently, if you observe the two following assertions of theirs. First, they affirm that a living creature is made merely by the assembling together of similar parts, which were hidden in those bodies from whence they are extracted in generation: whereas we say that bloud coming to a part to irrigate it, is by its passage through it, and some little stay in it, and by its frequent returns thither, at the length transmuted into the nature of that part: and thereby the specificall virtues of every part do grow greater, and are more diffused and extended.

Secondly, they say that the embryon is actually formed in the seed, though in such little parts as it cannot be discerned untill each part have enlarged and increased it self, by drawing unto it from the circumstant bodies more substance of their own nature. But we say, that there is one homogeneall substance, made of the bloud, which hath been in all parts of the body; and this is the seed: which containeth not in it, any figure of the animal from which it is refined, or of the animal into which it hath a capacity to be turned (by the addition of other substances) though it have in it the vertues of all the parts it hath often run through.

By which term of specifike vertues, I hope we have said enough in sundry places of this discourse to keep men from conceiving that we do mean any such unconceiveable quality, as modern Philosophers too frequently talk of, when they know not what they say or think, nor can give any account of. But that it is such degrees and such numbers, of rare and dense parts mingled together, as constitute a mixed body of such a temper and nature: which degrees and proportions of rare and dense parts and their mixture together, and incorporating into one homogeneall substance, is the effect resulting from the operations of the exteriour agent, that cutteth, imbibeth, kneadeth, and boyleth it to such a temper: which exteriour agent in this case, is each severall part of the animals body that this juice or bloud runneth through; and that hath a particular temper belonging to it, resulting out of such a proportion of rare and dense parts, as we have even now spoken of; and can no more be witheld from communicating its temper to the bloud that first soaketh into it, and soon after draineth away again from it (according as other succeeding parts of bloud drive it on;) then a minerall channell can choose but communicate its virtue unto a stream of water that runneth through it, and is continually grating of some of the substance of the minerall earth, and dissolving it into it self.

10. That the heart is imbued with the generall specifike virtues of the

But to go on with our intended discourse. The seed, thus imbued with the specificall virtues of all the severall parts of the parents body, meeting in a fit receptacle the other parents seed; and being there duly concocted, becometh first a heart: which heart

heart in this tender beginning of a new animal containeth the severall virtues of all the parts that afterwards will grow out of it, and be in the future animal; in the same manner as the heart of a cõplete animal containeth in it the specifike virtues of all the severall parts of its own body, by reason of the blouds continuall resorting to it in a circle from all parts of its body, and its being nourished by that juice to supply the continuall consumption which the extreme heat of it must needs continually occasion in its own substance; whereby the heart becometh in a manner the compendium or abridgement of the whole animal.

whole body; whereby is confirmed the doctrine of the two former paragraphes.

Now this heart in the growing Embryon, being of the nature of fire, as on the one side it streameth out its hot parts; so on the other it sucketh oyl or fewel to nourish it self out of the adjacent moist parts; which matter aggregated unto it, being sent abroad together with the other hot parts that steam from it; both of them together do stay and settle as soon as they are out of the reach of that violent heat, that would not permit them to thicken or to rest. And there they grow into such a substance as is capable to be made of such a mixture, and are linked to the heart by some of those strings that steam out from it (for those steams do likewise harden, as we shewed more particularly when we discoursed of the tender stalks of plants) and in a word, this becometh some other part of the animal. Which thus encreaseth by order, one part being made after another, untill the whole living creature be completely framed.

So that now you see, how mainly their opinion differeth from ours; since they say that there is actually in the seed a complete living creature; for what else is a living creature, but bones in such parts, nerves in such others, bloud and humours contained in such and such places, all as in a living creature? All which they say. But we make the seed to be nothing else but one mixed body, of one homogeneall nature throughout; consisting of such a multiplicity of rare and dense parts; so ballanced and proportioned in number and in magnitude of those parts; which are evenly shuffled, and alike mingled in every little parcel of the whole substance; in such sort, that the operation

on of nature upon this seed, may in a long time and with a due processe, bring out such figures, situation, and qualities (as fluidity, consistence, drinesse, and the like) which by much mixtion and consequent alteration, may in the end become such as constitute a living creature of such a kind. And thus it appeareth that although other substances, and liquours, and steams are from time to time mingled with the seed, and then with the heart, and afterwards with the other parts, as they grow on and encrease; yet the main virtue of the ensuing animal, is first in the seed, and afterwards in the heart.

Whence the reason is evident, why both defects and excrescences do passe sometimes from the parents to the children; to wit, when nothing supplyeth the defect or correcteth the exorbitancy. Rather after this which we have said, the difficulty will appear greater, in that such accidents are not alwayes hereditary from the parents; but happen only now & then some rare times. But the same grounds we have laid will likewise solve this objection: for seeing that the heart of the animal, from whence the seed receiveth its proper nature (as we have declared) is impregnated with the specifick virtue of each severall part of the body; it cannot be doubted but that the heart will supply for any defect happened in any part after it hath been imbued with that virtue, and is grown to a firmnesse, and vigorous consistence with that virtue moulded, and deeply imbibed into the very substance of it. And although the heart should be tincted from its first origine with an undue virtue from some part (as it seemeth to have been in the mother of those daughters that had two thumbes upon one hand:) yet it is not necessary that all the offspring of that parent should be formed after that modell; for the other partners seed may be more efficacious, and predominate in the geniture, over the faulty seed of the other parent; and then it will supply for and correct the others deviation from the generall rule of nature. Which seemeth to be the case of that womans male children; for in them the fathers seed beeing strongest, all their fingers imitated the regularity of their fathers: whereas the daughters (whose sex implieth that the fathers seed was lesse active) carried upon some of theirs, the resemblance of their mothers irregularity.

And

And in confirmation of this doctrine, we daily see that the children of parents who have any of their noble parts much and long distempered, whereby there must be a great distemper in the bloud (which is made and concocted by their assistance) do seldome fail of having strong inclinations to the distempers and diseases that either of their parents were violently subject unto. Scarce any father or mother dieth of the consumption of the lungs, but their children inherit that disease in some measure: the like is of the stone; the like of the gout; the like of diseases of the brain, and of sundry others; when they infested the parents with any notable eminency. For the bloud coming continually to the heart from such ill-affected parts, by its circulation through the whole body, must needs in processe of time alter, and change the temper of the heart: and then both the heart giveth a tainted impression to the bloud that must be boyled into seed; and the parts themselves do communicate their debilities and distempers unto it: so that it is no wonder, if the seed do partake of such depraved qualities; since it is a maxime among Physicians, that subsequent concoctions can never amend or repair the faults of the precedent ones.

II. That the heart is the first part generated in a living creature.

Having waded thus farre into this matter, and all experience agreeing that the whole animal is not formed at once: I conceive there can be no great difficulty in determining what part of it is first generated: which we have already said to be the heart; but peradventure the Reader may expect some more particular and immediate proof of it. It is evident that all the motions and changes which we have observed in the egge and in the Doe, do proceed from heat: and it is as certain that heat is greatest in the center of it: from whence it dispersеth it self to lesse and lesse. It must then necessarily follow, that the part in which heat doth most abound, and which is the interiour fountain of it, from whence (as from a stock of their own) all the other parts derive theirs; must be formed first and the others successively after it, according as they partake more or lesse of this heat; which is the Architect that mouldeth and frameth them all. Undoubtedly this can be none other but the heart: whose motion and manner of working, evidently appears in the twinckling of the first red spot (which is the first change) in the egge, and in the first

first matter of other living creatures. Yet I do not intend to say, that the heart is perfectly framed, and completely made up, with all its parts and instruments, before any other part be begun to be made: but onely the most vertuous part; and as it were the marrow of it; which serveth as a shop or a hot forge to mould spirits in: from whence they are dispersed abroad to form and nourish other parts that stand in need of them to that effect.

The shootings or little red strings that stream out from it, must surely be arteries; through which, the bloud issuing from the heart, and there made and imbued with the nature of the seed, doth runne; till encountering with fit matter, it engrosseth it self into brain, liver, lights, &c. From the brain chiefly groweth the marrow, and by consequent, the bones containing it, (which seem to be originally, but the outward part of the marrow, baked and hardened into a strong crust by the great heat that is kept in:) as also the sinews; which are the next principall bodies of strength, after the bones. The marrow being very hot drieth the bones; and yet with its actuall moysture it humecteth and nourisheth them too, in some sort. The spirits that are sent from the brain do the like to the sinewes. And lastly, the arteries and veins by their bloud do cherish and bedew the flesh. And thus the whole living creature is begun, framed, and made up.

## CHAP. XXV.

### *How a Plant or Animall cometh to that figure it hath.*

I. That the figure of an Animall is produced by ordinary second causes, as well as any other corporeall effect.

BUt before we go any further, and search into the operations of this animall, a wonderfull effect calleth our consideration unto it: which is, how a plant or animall cometh by the figure it hath, both in the whole and in every part of it? Aristotle, after he had beaten his thoughts as far as he could upon this question, pronounced that this effect could not possibly be wrought by the virtue of the first qualities; but that it sprung from a more divine origine. And most of the contemplatours of Nature since him do seem to agree, that no cause can be rendered of it; but that it is to be referred merely to the specificall nature

nature of the thing. Neither do we intend to derogate from either of these causes; since that both divine providence is eminently shown in contriving all circumstances necessary for this work; and likewise, the first temperament that is in the seed must needs be the principall immediate cause of this admirable effect.

This latter then being supposed; our labour and endeavour will be, to unfold (as farre as so weak and dimme eyes can reach) the excellency and exactnesse of Gods providence, which cannot be enough adored, when it is reflected upon, and marked in the apt laying of adequate causes to produce such a figure out of such a mixture first layed. From them so artificially ranged, we shall see this miracle of nature to proceed; and not from an immediate working of God or nature without convenient and ordinary instruments to mediate and effect this configuration, through the force and virtue of their own particular natures. Such a necessity to intereſt the chief workman at every turn, in particular effects, would argue him of want of skill and providence, in the first laying of the foundations of his designed machine: he were an improvident clockmaker, that should have cast his work so, as when it were wound up and going, it would require the masters hand at every houre to make the hammer strike upon the bell. Let us not then too familiarly, and irreverently ingage the Almighty Architect his immediate handy-work in every particular effect of of nature; *Talis non est dignus vindice nodus.*

2. That the severall figures of bodies proceed from a defect in one of the three dimensions, caused by the concurrance of accidentall causes.

But let us take principles within our own kenning; and consider how a body hath of its own nature three dimensions, (as Mathematicians use to demonstrate:) and that the variety which we see of figures in bodies proceedeth out of the defect of some of these dimensions in proportion to the rest. As for example, that a thing be in the form of a square tablet; is, for that the cause which gave it length and breadth, could not also give it thicknesse in the same proportion: for had it been able to give profundity as well as the other two, it had made a cube instead of a tablet. In like manner, the forme of a lamine, or very long square is occasioned by some accident which hindereth the cause from giving breadth and thicknesse proportiona-

tionable to the length. And ſo, other figures are made, by reaſon that their cauſes are ſome wayes bound to give more of ſome dimenſion to one part then to another.

As for example, when water falleth out of the skie, it hath all the little corners or extancies of its body grated off by the aire as it rolleth and tumbleth down in it, ſo that it becometh round; and continueth in that form, untill that ſettling upon ſome flat body, as graſſe or a leaf, it receiveth a little plainneſſe, to the proportion of its weight maſtering the continuitie of it. And therefore, if the drop be great upon that plain body, it ſeemeth to be half a ſphere, or ſome leſſe portion of one: but if it be a little drop then the flat part of it (which is that next unto the graſſe) is very little and undiſcernable, becauſe it hath not weight enough to preſſe it much and ſpread it broad upon the graſſe; and ſo the whole ſeemeth in a manner to be a ſphere: but if the extern cauſes had preſſed upon this drop, onely broadwayes and thickwayes (as when a turner maketh a round pillar of a ſquare one) then it would have proved a cylinder, nothing working upon it to grate off any of its length, but onely the corners of the breadth and thickneſſe of it.

And thus you ſee, how the fundamentall figures (upon which all the reſt are grounded) are contrived by nature; not by the work of any particular Agent that immediately imprinteth a determinate figure into a particular body, as though it wrought it there at once, according to a foreconceived deſigne or intelligent aime of producing ſuch a figure in ſuch a body: but by the concurrence of ſeverall accidentall cauſes, that do all of them joyn in bringing the body they file and work upon, into ſuch a ſhape.

Onely we had like to have forgotten the reaſon and cauſe of the concave figure in ſome parts of plants: which in the ordinary courſe of nature we ſhall find to grow from hence, that a round outſide being filled with ſome liquor which maketh it grow higher and higher, it happeneth that the ſucceeding cauſes do contract this liquor, and do harden the outſide: and then of neceſſity there muſt be a hollow cylinder remaining in lieu of the juice which before did fill it. As we ſee every day in corn,

and

and in reeds, and in canes, and in the ſtalks of many herbs: which whileſt they are tender and in their firſt groweth, are full of juice, and become afterwards hollow and dry.

3. The former doctrine is confirmed by ſeverall inſtances.

But becauſe this diſcourſe, may peradventure ſeem too much in common: it will not be amiſſe to apply it to ſome particulars that ſeem very ſtrange. And firſt, let us examine how the rocking of concrete juices (which ſeemeth to be ſuch an admirable myſtery of nature) is performed. Allom falleth down in lumps, ſaltpeter in long icicles, and common ſalt in ſquares; and this, not once, or ſometimes now and then; but alwayes conſtantly in the ſame order.

The reaſon of theſe effects will eaſily be deduced out of what we have ſaid, for if all three be diſſolved in the ſame water, allom being the groſſeſt falleth firſt and faſteſt: and being of an unctious nature, the firſt part which falleth doth not harden till the ſecond cometh to it; whereby this ſecond ſticketh to the firſt and cruſheth it down, and this is ſerved in the ſame manner by the third; and ſo goeth on, one part ſqueezing another, till what is undermoſt grow hard enough to reſiſt the weight of new falling parts; or rather till no more do fall, but the liquor they were diſſolved in, is delivered of them all, and then they harden in that figure they were compreſſed into.

As for ſalt, which deſcendeth in the ſecond place: that ſwimmeth firſt upon the water; and there, getteth its figure, which muſt be equally long and broad, becauſe the water is indifferent to thoſe two poſitions; but its thickneſſe is not equall to its other two dimenſions, by reaſon that before it can attain to that thickneſſe, it groweth too heavie to ſwimme any longer; and after it is encreaſed to a certain bulk, the weight of it carrieth it down to the bottome of the water, and conſequently, it can encreaſe no more: for it encreaſeth by the joyning of little parts unto it as it ſwimmeth on the toppe of the water.

The ſaltpeter falleth laſt: which being more difficult to be figured then the other two, becauſe it is more dry then either of them (as conſiſting chiefly of earthy and of fiery parts,) is not equally encreaſed, neither in all three, nor in two dimenſions, but hath its length exceeding both its breadth and thickneſſe:

and

and its lightneſſe maketh it fall laſt, becauſe it requireth leaſt water to ſuſtain it.

To give the cauſes of the figures of divers mixts, and particularly of ſome pretious ſtones, (which ſeem to be caſt by nature in exacteſt moulds) would oblige us to enter into the particular manner of their generation: which were exceeding hard, if not impoſſible, for us to do, by reaſon that Authours have not left us the circumſtances upon which we might ground our judgement concerning them, ſo particularly deſcribed as were neceſſary; nor our ſelves have met with the commodity of making ſuch experiences, and of ſearching ſo into their beds as were requiſite, to determine ſolidely the reaſons of them. And indeed I conceive that oftentimes the relations which others have recorded of their generation, would rather miſſeleade then aſſiſt us: ſince it is very familiar in many men, to magnifie the exactneſſe of nature in framing effects they phanſie to themſelves, when to make their wonder appear more juſt; they will not fail to ſet off their ſtory, with all advantagious circumſtances, and help out what wanteth a little or cometh but near the mark.

4. The ſame doctrine applied to Plants.

But to come cloſer to our purpoſe; that is, to the figures of living things: we ſee that roots in the earth are all of them figured almoſt in the ſame faſhion: for the heat reſiding in the middeſt of them, puſheth every way, and thereupon, ſome of them do become round, but others more long then round, according to the temper of the ground, or to the ſeaſon of the yeare, or to the weather that happeneth: and this, not onely in divers kinds of roots, but even in ſeverall of the ſame kind. That part of the plant which mounteth upwards is for the moſt part round and long; the cauſe whereof is evident, for the juice which is in the middle of it working upwards (becauſe the hardneſſe of the bark will not let it out at the ſides) and coming in more and more abundance (for the reaſons we have above delivered) encreaſeth that part equally every way but upwards; and therefore, it muſt be equally thick and broad, and conſequently round: but the length will exceed either of the other dimenſions; becauſe the juice is driven up with a greater force and in more quantity then it is to the ſides. Yet the

the broadneſſe and thickneſſe are not ſo exactly uniform, but that they exceed a little more at the bottom then at the toppe; which is occaſioned partly by the contracting of the juice into a narrower circuit the further it is from the ſource; and partly by reaſon of the branches; which ſhooting forth, do convey away a great part of the juice from the main ſtock.

5. The ſame doctrine declared in leafs of trees.

Now if we conſider the matter well; we ſhall find, that what is done in the whole tree the very ſame is likewiſe done in every little leaf of it: for a leaf conſiſteth of little branches ſhooting out from one greater branch, which is in the middle: and again, other leſſer branches are derived from thoſe ſecond branches: and ſo ſtill leſſer and leſſer, till they weave themſelves into a cloſe work, as thick as that which we ſee women uſe to fill up with ſilk or crewell, when in tentwork they embroader leafs or flowers upon canvas: and this again, is covered and as it were glewed over, by the humour which ſticking to theſe little thriddes, ſtoppeth up every little vacuity, and by the ayre is hardned into ſuch a skinne as we ſee a leaf conſiſteth of.

And thus it appeareth how an account may be given of the figure of the leafs, as well as of the figure of the main body of the whole tree: the little branches of the leaf, being proportionate in figure to the branches of the tree it ſelf (ſo that each leaf ſeemeth to be the tree in little;) and the figure of the leaf depending of the courſe of theſe little branches, ſo that if the greateſt branch of the tree be much longer then the others, the leaf will be a long on: but if the leſſer branches ſpread broadwayes, the leaf will likewiſe be a broad one; ſo farre, as even to be notched at the outſides, round about it, in great or little notches, according to the proportion of the trees branches. Theſe leafs, when they firſt break out are foulded inwards, in ſuch ſort as the ſmalneſſe and roundneſſe of the paſſage in the wood through which they iſſue, conſtraineth them to be: where nevertheleſſe the drineſſe of their parts keep them aſunder, ſo that one leaf doth not incorporate it ſelf with another: but as ſoon as they feell the heat of the ſunne (after they are broken out into liberty) their tender branches by little and little grow

grow more straight: the concave parts of them drawing more towards the sunne, because he extracteth and sucketh their moysture from their hinder parts into their former, that are more exposed to his beams; and thereby the hinder parts are contracted and grow shorter, and those before grow longer. Which if it be in excesse, maketh the leaf become crooked the contrary way, as we see in divers flowers, and in sundery leafs during the summers heat: witnesse, the Ivie, Roses full blown, Tulips, and all flowers in form of bells: and indeed all kinds of flowers whatsoever, when the sunne hath wrought upon them to that degree we speak of, and that their joyning to their stalk, and the next parts thereunto, allow them scope to obey the impulse of those outward causes. And when any do vary from this rule, we shall as plainly see other manifest causes producing those different effects, as now we do these working in this manner.

As for fruits though we see that when they grow at liberty upon the tree, they seem to have a particular figure allotted them by nature: yet in truth, it is the ordered series of naturall causes and not an intrinsecall formative virtue which breedeth this effect, as is evident by the great power which art hath to change their figures at pleasure: whereof you may see examples enough in Campanella, and every curious gardner can furnish you with store.

6. The same applied to the bodies of Animals

Out of these, and such like principles a man that would make it his studdy with lesse trouble or tediousnesse, then that patient contemplator of one of natures little works (the Bees) whom we mentioned a while agone, might without all doubt trace the causes in the growing of an Embryon, till he discovered the reason of every bones figure; of every notable hole or passage that is in them: of the ligaments by which they are tied together: of the membranes that cover them, and of all the other parts of the body. How, out of a first masse, that was soft, and had no such parts distinguishable in it, every one of them came to be formed, by contracting that masse in one place, by dilating it in another, by moystning it in a third, by drying it here, hardening it there:

*Ut*

*—Ut his exordia primis,*
*Omnia, & ipse tener hominis concreverit orbis.*

till in the end this admirable machine and frame of mans body, was composed and fashioned up by such little and almost insensible steps and degrees. Which when it is looked upon in bulk, and entirely formed, seemeth impossible to have been made, and to have sprung merely out of these principles, without an Intelligence immediately working and moulding it at every turn, from the beginning to the end.

But withall, we cannot chuse but break out into an exstasie of admiration and hymnes of praise (as great Galen did upon the like occasion) when we reverently consider the infinite wisedome, and deep farre-looking providence of the all-seeing Creatour and orderer of the world, in so punctually adapting such a multitude and swarm of causes to produce by so long a progresse so wonderfull an effect: in the whole course of which, if any one, the very least of them all, went never so little awry, the whole fabrick would be discomposed and changed from the nature it is designed unto.

7. In what sense the Authour doth admit of *Vis formatrix*.

Out of our short survey of which (answerable to our weak talents, and slender experience) I perswade my self it appeareth evident enough, that to effect this worke of generation, there needeth not be supposed a forming virtue or *Vis formatrix* of an unknown power and operation, as those that consider things suddenly and but in grosse, do use to put. Yet in discourse, for conveniency and shortnesse of expression we shall not quite banish that terme from all commerce with us; so that what we mean by it be rightly understood, which is the complex assemblement, or chain of all the causes, that concur to produce this effect, as they are set on foot to this end by the great Architect and Moderatour of them, God Almighty, whose instrument Nature is: that is, the same thing, or rather the same things so ordered as we have declared, but expressed and comprised under another name.

## CHAP. XXVI.

*How motion beginneth in living creatures. And of the motion of the heart; circulation of the bloud; Nutrition, Augmentation, and corruption or death.*

1. From whence doth proceed the primary motion and growth in plants.

But we must not take our leave of this subject, untill we have examined, how motion beginneth in living things; as well plants as sensitive creatures. We can readily pitch upon the part we are to make our observations in, for retriving the origine of this primary motion: for having concluded that the roots of plants, and the hearts of animals are the parts of them which are first made, and from which the forming virtue is derived to all the rest, it were unreasonable to seek for their first motion any where else.

But in what manner, and by what means, doth it beginne there? for roots, the difficulty is not great: for the moysture of the earth pressing upon the seed, and soaking into it; the hot parts of it which were imprisoned in cold and dry ones, are thereby stirred up and set on work: then they mingling themselves with that moysture, do ferment and distend the whole seed; till making it open, and break the skinne more juice cometh in: which incorporating it selfe with the heat, those hot and now moyst parts will not be contained in so narrow a roome as at the first; but struggling to get out on all sides, and striving to enlarge themselves, they thrust forth little parts: which, if they stay in the earth, do grow white and make the root; but those which ascend, and make their way into the aire, being lesse compressed, and more full of heat and moysture, do turn green: and as fast as they grow up, new moysture coming to the root, is sent up through the pores of it: and this faileth not, untill the heat of the root it self doth fail. For it being the nature of heat to rarifie and elevate, there must of necessity be caused in the earth a kind of sucking in of moysture into the root from the next parts unto it to fill those capacities which the dilating heat hath made that

else

else would be empty, and to supply the roomes of those which the heat continually sendeth upwards: for the moysture of the root hath a continuity with that in the earth, and therefore, they adhere together (as in a pump, or rather as in filtration) and do follow one another when any of them are in motion, and still the next must needs come in, and fill the roome, where it findeth an empty space immediate to it. The like of which happeneth to the aire when we breathe: for our lungs being like a bladder, when we open them, the aire must needs come in, to fill that capacity which else would be emptie: and when we shut them again; as in a pair of bellows we put it out.

2. Monsieur des Cartes his opinion touching the motion of the heart.

This may suffice, concerning the primary motion of roots: but in that of the heart; we shall find the matter not altogether so plain, Monsieur des Cartes following herein the steps of the learned and ingenuous Doctour Harvey, who hath invented and teacheth that curious and excellent doctrine of the circulation of the bloud; (as indeed, what secret of nature can be hidden from so sharp a wit, when he applyeth himself to penetrate into the bottome of it:) explicateth the matter much after this sort. That the heart, within, in the substance of it, is like a hollow cavern; in whose bottome, were an hot stone; on which should drop as much liquour as the fiery stone could blow into smoke; and this smoke or steam should be more then the cave could contain; wherefore it must break out; which to do, it presseth on all sides to get an issue or doore to let it out: it findeth of two sorts, but onely one kind of them will serve it for this purpose; for the one sort of these doores, openeth inwards, the other outwards: which is the cause that the more it striveth to get out, the faster it shutteth the doores of the first kind; but by the same means, it beateth back the other doores, and so getteth out.

Now when it is gone quite out of this cavern, and consequently leaveth it to its naturall disposition; whereas before it violently stretched it out; and by doing so kept close the doores that open inwards: then all the parts of it begin to slacken; and those doores give way unto new liquour to drop in anew; which the heat in the bottome of the heart, rarifieth again

into smoke as before. And thus he conceiveth the motion of the heart to be made, taking the substance of it to be (as I may say) like unto limber leather, which upon the filling of it with bloud and steam, openeth and dilateth it self: and at the going of it out, it shrinketh together like a bladder.

3. The former opinion rejected.

But I doubt, this explication will not go through the difficulty: for first, both Galen and Doctour Harvey do shew, that as soon as the bloud is come into the heart, it contracteth it self: which agreeth not with Monsieur des Cartes his supposition: for in his doctrine, there appeareth no cause why it should contract it self when it is full: but contrariwise, it should go on dilating it self, untill enough of the bloud which droppeth into the heart, were converted into steam, to force the doores open; that so, it may gain an issue thence, and a passage into the body.

Next, Monsieur des Cartes supposeth that the substance of the heart is like a bladder, which hath no motion of it self, but openeth and shutteth, according as what is within it stretcheth it out, or permitteth it to shrink and fall together again. Whereas Doctour Harvey proveth that when it is full, it compresseth it self by a quick and strong motion, to expell that which is in it; and that when it is empty, it returneth to its naturall dilatation, figure and situation, by the ceasing of that agents working, which caused its motion. Whereby it appeareth to be of such a fibrous substance, as hath a proper motion of its own.

Thirdly, I see not how this motion can be proportionall; for the heart must needs open and be dilated much faster then it can be shut and shrink together: there being no cause put to shut it and to bring it to its utmost period of shrinking, other then the going out of the vapour, whereby it becometh empty: which vapour not being forced by any thing but by its own inclination, it may peradventure at the first when there is abundance of it, swell and stretch the heart forcibly out; but after the first impulse and breach of some part of it out of the caverne that encloseth it, there is nothing to drive out the rest, which must therefore steam very leisurely out.

Fourth-

Fourthly, what should hinder the bloud from coming in, before the heart be quite empty and shrunk to its lowest pitch? For as soon as the vapour yieldeth within, new bloud may fall in from without; and so keep the heart continually dilated, without ever suffering it to be perfectly and completely shut.

Fifthly, the heart of a viper layed upon a plate in a warm place will beat foure and twenty houres, and much longer, if it be carefully taken out of its body, and the weather be warm and moyst: and it is clear, that this is without succession of bloud to cause the pulses of it. Likewise, the severed members of living creatures will stirre for some time after they are parted from their bodies: and in them, we can suspect no such cause of motion.

Sixthly, in Monsieur des Cartes his opinion, the heart should be hardest when it is fullest; and the eruption of the steam out of it, should be strongest at the beginning, whereas experience sheweth, that it is softest when it is at the point of being full, and hardest when it is at the point of being empty; and the motion strongest, towards the end.

Seventhly, in Monsieur des Cartes his way, there is no agent or force strong enough to make bloud gush out of the heart: for if it be the steam onely that openeth the doores, nothing but it will go out; and the bloud will still remain behind, since it lieth lower then the steam, and further from the issue that letteth it out: but Doctor Harvey findeth by experience (and teacheth how to make this experience) that when a wound is made in the heart, bloud will gush out by spurts at every shooting of the heart.

And lastly, if Monsieur des Cartes his supposition were true, the arteries would receive nothing but steams; whereas it is evident that the chief filler of them is bloud.

4. The Authours opinion concerning the motion of the heart.

Therefore we must enquire after another cause of this primary motion of a sensitive creature, in the beatings of its heart. Wherein we shall not be obliged to look farre: for seeing we find this motion and these pulsations in the heart when it is separated from the body, we may boldly and safely conclude, that it must of necessity be caused by something that is within

within the heart it ſelf. And what can that be elſe, but heat or ſpirits impriſoned in a tough viſcuous bloud; which it cannot ſo preſently break through to get out; and yet can ſtirre within it, and lift it up?

The like of which motion may be obſerved, in the heaving up, and ſinking down again of looſe mould thrown into a pit, into which much ordure hath been emptied. The ſame cauſe, of heat in the earth, maketh mountains and ſands to be caſt up in the very ſea: ſo, in frying, when the pan is full of meat, the bubbles riſe and fall at the edges: treacle, and ſuch ſtrong compounded ſubſtances; whiles they ferment, do lift themſelves up and ſink down again, after the ſame manner as the vipers heart doth: as alſo do the bubbles of barm, and muſt of wine: and ſhort ends of lute ſtrings baked in a juicy pie, will at the opening of it move in ſuch ſort, as they who are ignorant of the feat will think there are magots in it: and a hot loaf, in which quickſilver is encloſed, will not onely move thus, but will alſo leap about, and skip from one place to another, like the head or limbe of an animall (very full of ſpirits) newly cut off from its whole body.

And that this is the true cauſe of the hearts motion, appeareth evidently. Firſt, becauſe this virtue of moving is in every part of the heart, as you will plainly ſee if you cut into ſeverall pieces a heart, that conſerveth its motion long after it is out of the animals belly: for every piece will move; as Doctor Harvey aſſureth us by experience, and I my ſelf have often ſeen, upon occaſion of making the great antidote, in which vipers hearts is a principall ingredient. Secondly, the ſame is ſeen in the auricles and the reſt of the heart; whoſe motions are ſeverall; though ſo near together, that they can hardly be diſtinguiſhed. Thirdly, Doctor Harvey ſeemeth to affirm that the bloud which is in the ears of the heart, hath ſuch a motion of it ſelf, precedent to the motion of the ears it is in: and that this virtue remaineth in it for a little ſpace after the ears are dead. Fourthly, in touching a heart which had newly left moving, with his finger wetted with warm ſpittle, it began to move again, as teſtifying that heat and moiſture made this motion. Fifthly, if you touch the vipers heart over with vineger,

with

with ſpirit of wine, with ſharp white wine, or with any piercing liquour; it preſently dyeth: for the acuteneſſe of ſuch ſubſtances pierceth through the viſcuous bloud, and maketh way for the heat to get out.

But this firſt mover of an animall, muſt have ſomething from without to ſtirre it up; elſe, the heat would lie in it, as if it were dead; and in time would become abſolutely ſo. In egges, you ſee this exteriour mover, is the warmth of the henne hatching them. And in Embryons, it is the warmth of the mothers wombe. But when in either of them, the heart is completely formed, and is encloſed in the breaſt; much heat is likewiſe encloſed there, in all the parts near about the heart; partly made by the heart it ſelf, and partly cauſed by the outward heat, which helped alſo to make that in the heart: and then although the warmth of the hen or of the mothers womb, do forſake the heart; yet this ſtirreth up the native heat within the heart and keepeth it in motion, and maketh it feed ſtill upon new fewell, as faſt as that which it worketh upon decayeth.

5. The motion of the heart dependeth originally of its fibers irrigated by bloud.

But to expreſſe more particularly how this motion is effected; we are to note, that the heart hath in the ventricles of it three ſorts of fibers: the firſt go long wayes or are ſtraight ones, on the ſides of the ventricles from the thick baſis of the heart, towards the little rip or cone of it: the ſecond, go croſſe or roundwayes about the ventricles within the heart: and the third, are tranſverſall or thwart ones. Next, we are to remember, that the heart is fixed to the body by its baſe; and hangeth looſe at the cone. Now then, the fibers being of the nature of ſuch things as will ſwell and grow thicker by being moiſtened, and conſequently ſhrink up in length and grow ſhorter in proportion to their ſwelling thicker (as you may obſerve in a looſe wrought hempen rope) it muſt of neceſſity follow, that when the bloud falleth into the heart (which is of a kind of ſpungie ſubſtance) the fibers being therewith moiſtened, they will preſently ſwell in roundneſſe and ſhrink in length.

Next, we are to note, that there is a double motion in the heart: the one of opening, which is called, Diaſtole; the other of ſhutting, which is termed Syſtole. And although Doctour Harvey ſeemeth to allow the opening of the heart to be no motion;

but rather a relenting from motion; nevertheleſſe (me thinketh) it is manifeſt, that it is not onely a compleat motion; but in a manner the greater motion of the two, though indeed the leſſe ſenſible; becauſe it is performed by little and little; for in it the heart is drawn by violence from its naturall poſition; which muſt be (as it is of all heavy things) that by which it approacheth moſt to the center of gravity; and ſuch a poſition we ſee it gaineth by the ſhutting of it.

Now to declare how both theſe motions are effected, we are to conſider how at the end of the ſyſtole the heart is voided and cleanſed of all the bloud that was in it; whence it followeth, that the weight of the bloud which is in the auricles, preſſing upon the *valvalas* or doores that open inwards, waketh its way by little and little into the ventricles of the heart, where it muſt neceſſarily ſwell the fibers; and they being ſwelled muſt needs draw the heart into a roundiſh and capacious figure, which the more it is done, the more bloud cometh in, and with greater violence. The following effect of which muſt be, that the weight of the bloud joyned to the weight of the heart it ſelf, and particularly of the *conus* or tip (which is more ſolid and heavie in proportion to its quantity, then the reſt of the heart) muſt neceſſarily ſet the heart into the natural motion of deſcending according to its gravity: the which conſequently, is performed by a lively jerck, whereby it cometh to paſſe that the tip of our heart doth as it were ſpring up towards our breaſt: & the bloud is ſpurted out by other *valvulæ* (that open outwards) which are aptly diſpoſed to be opened upon ſuch a motion, & do convey it to the arteries.

In the courſe of which motion, we may note how the figure of our heart contributeth to its ſpringing up towards our breaſt; for the line of diſtance which is between the baſis & the tip being longer on that ſide which is towards the back, then on the other which is towards the breaſt, it muſt happen that when the heart ſhutteth and ſtraighteneth it ſelf, and thereby extendeth it ſelf to its length, the tip will butte out forwards towards the breſt.

6. An objection anſwered againſt the former doctrine.

Againſt this doctrine of the motion, and of the ſyſtole and diaſtole of the heart, it may be objected, that beaſts hearts do not hang like a mans heart, ſtraight downwards; but rather horizontally; and therefore this motion of gravity cannot have

place

place in them: nevertheleſſe, we are ſure they beat, and do open and ſhut regularly. Beſides, if there were no other cauſe but this of gravity for the motion of a mans heart, it would follow that one who were ſet upon his head or hung by his heels, could not have the motion of his heart: which poſture nevertheleſſe, we ſee men remain in for a pretty while, without any extreme prejudice.

But theſe difficulties are eaſily anſwered; for whether beaſts hearts do lie directly horizontally, or whether the baſis be faſtened ſomewhat higher then the tip reacheth, and ſo maketh their heart hang inclining downwards; ſtill the motion of gravity hath its effect in them. As we may perceive in the heart of a viper lying upon a plate, and in any other thing that of it ſelf ſwelleth up, and ſtraight again ſinketh down: in which we cannot doubt, but that the gravity fighting againſt the heat, maketh the elevated parts to fall, as the heat maketh them riſe.

And as for the latter; it is evident that men cannot ſtay long in that poſture without violent accidents; and in any little while we ſee that the bloud cometh into their face and other parts which naturally are ſituated higher; but by this poſition become lower then the heart: and much time is not required, to have them quite diſordered and ſuffocated; the bloud paſſing through the heart with too much quickneſſe, and not receiving due concoction there; and falling thence in too great abundance into places that cannot with conveniency entertain it.

But you will inſiſt, and ask, whether in that poſture the heart doth move or no, and how? And to ſpeak by gueſſe in a thing I have not yet made experiences enough to be throughly informed in; I conceive without any great ſcruple that it doth move. And that it happeneth thus; that the heart hanging ſomewhat looſe, muſt needs tumble over, and the tip of it lean downwards ſome way or other; and ſo lie in part like the heart of a beaſt; though not ſo conveniently accommodated: and then the heat which maketh the viſcuous bloud that is in the ſubſtance of the heart to ferment will not fail of raiſing it up: whereupon the weight of that ſide of the heart that is lifted up, wil preſently preſſe it down again. And thus, by the alternative operations of theſe

cauſes,

causes, the heart will be made to open and shut it self, as much as is necessary for admitting and thrusting out, that little and disorderly coming bloud, which maketh its course through it, for that little space wherein the man continueth in that position.

7. The circulation of the bloud, & other effects that follow the motion of the heart.

Now from these effects wrought in the heart by the moistening of the fibers, two other effects do proceed: the one is, that the bloud is pushed out of every corner of the heart with an impetuousnesse or velocity. The other is, that by this motion the spirits which are in the ventricles of the heart, and in the bloud that is even then heated there, are more and deeper pressed into the substance of the heart, so that you see the heart imbibeth fresh vigour, and is strengthened with new spirits, whiles it seemeth to reject that which should strengthen it.

Again, two other effects follow this violent ejection of the bloud out of the heart. The one is, that for the present the heart is entirely cleansed of all remainders of bloud, none being permitted to fall back to annoy it. The other is, that the heart finding it self dry, the fibers do relent presently into their naturall position and extension, and the valvulæ that open inwards, fall flat to the sides of the ventricles, and consequently new bloud droppeth in. So that in conclusion, we see the motion of the heart dependeth originally of its fibers irrigated by the bloud, and not from the force of the vapour, as Monsieur des Cartes supposeth.

This motion of the heart driveth the bloud (which is warmed and spiritualized, by being boyled in this furnace) through due passages into the arteries, which from them runneth into the veins, and is a main cause of making and nourishing other parts; as the liver, the lungs, the brains, and whatsoever else dependeth of those veins and arteries through which the bloud goeth. Which being ever freshly heated, and receiving the tincture of the hearts nature, by passing through the heart, wheresoever it stayeth and curdleth, it groweth into a substance of a nature conformable to the heart, though every one of such substances be of exceeding different conditions in themselves, the very grossest excrements not being excluded from some participation of that nature.

But

But if you desire to follow the bloud all along every step in its progresse from the heart round about the body, till it return back again to its center, Doctour Harvey who most acutely teacheth this doctrine, must be your guide. He will shew you how it issueth from the heart by the arteries, from whence it goeth on warming the flesh, untill it arrive to some of the extremities of the body: and by then it is grown so cool (by long absence from the fountain of its heat; and by evaporating its own stock of spirits, without any new supply) that it hath need of being warmed anew; it findeth it self returned back again to the heart, and is there heated again, which return is made by the veins, as its going forwards is performed onely by the arteries.

And were it not for this continuall circulation of the bloud, and this new heating it in its proper caldron, the heart; it could not be avoided but that the extreme parts of the body would soon grow cold and die. For flesh being of it self of a cold nature (as is apparent in dead flesh) and being kept warm, merely by the bloud that bedeweth it; and the bloud likewise being of a nature that soon groweth cold and congealeth, unlesse it be preserved in due temper by actuall heat working upon it: how can we imagine that they two singly, without any other assistance, should keep one another warm (especially in those parts that are farre distant from the heart) by onely being together? Surely we must allow the bloud, (which is a substance fit for motion) to have recourse back to the heart, (where onely it can be supplyed with new heat and spirits) and from thence be driven out again by it pulses or strokes, which are his shuttings. And as fast as it flieth out, (like a reeking thick steam, which riseth from perfumed water falling upon a heated pan) that which is next before it must flie yet further on, to make way for it; and new arteriall bloud still issuing forth at every pulse, it must still drive on what issued thence the last precedent pulse, and that part must presse on what is next before it. And thus it fareth with the whole masse of bloud, which having no other course but in the body, it must at length run round, and by new vessels (which are the veins) return back unto the place from whence it issued first: and by that time it cometh thither, it is grown cool and thick, and needeth a vigorous restauration of spirits

spirits and a new rarifying; that then it may warm the flesh it passeth again through: without which it would suddenly grow stone cold, as is manifest if by tying or cutting the arteries, you intercept the bloud which is to nourish any part: for then that part groweth presently cold and benummed.

8. Of Nutrition.

But referring the particulars of this doctrine unto Doctour Harvey (who hath both invented and perfected it) our task in hand calleth upon us to declare in common the residue of motions that all living creatures agree in. How generation is performed we have determined in the past discourse. Our next consideration then ought to be of Nutrition and Augmentation. Between which there is very little difference in the nature of their action; and the difference of their names is grounded more upon the different result in the period of them, then upon the thing it self; as will by and by appear. Thus then is the progresse of this matter: as soon as a living creature is formed, it endeavoureth straight to augment it self; and employeth it self onely about that; the parts of it being yet too young and tender to perform the other functions which nature hath produced them for. That is to say; the living creature, at its first production, is in such a state and condition as it is able to do nothing else, but (by means of the great heat that is in it) to turn into its own substance the abundance of moysture that overfloweth it.

They who are curious in this matter, do tell us that the performance of this work consisteth in five actions; which they call Attraction, Adhesion, Concoction, Assimilation, and Unition. The nature of attraction we have already declared when we explicated how the heart and the root sendeth juyce into the other parts of the animal or plant: for they abounding in themselves with inward heat, and besides that, much other circumstant heat working likewise upon them; it cannot be otherwise, but that they must needs suck and draw into them, the moysture that is about them.

As for adhesion, the nature of that is likewise explicated, when we shewed how such parts as are moist but especially aereall or oily ones (such as are made by the operation of a soft and continuall heat) are catching and do easily stick unto any body

body they happen to touch: and how a little part of moysture between two dry parts, joyneth them together. Upon which occasion, it is to be noted that parts of the same kind do joyn best together: and therefore the powder of glasse is used to ciment broken glasse withall (as we have touched somewhere above:) and the powder of marble to ciment marble with; and so of other bodies: in like manner, Alchymists find no better expedient to extract a small proportion of silver mixed with a great one of gold, then to put more silver to it: nor any more effectuall way to get out the heart, or tincture, or spirits of any thing they distill or make an extract of, then to infuse its own flegme upon it, and to water it with that. Now whether the reason of this be, that continuity, because it is an unity, must be firmest between parts that are most conformable to one another, and consequently are most one among themselves; or whether it be for some other hidden cause, belongeth not to this place to discourse: but in fine so it is. And the adhesion is strongest of such parts as are most conformable to that which needeth encrease and nourishment; and that is made up by the other three actions.

Of which, concoction is nothing else but a thickning of that juyce which already sticketh to any part of the animals body, by the good digestion that heat maketh in it. And assimilation is the effect of concoction: for this juyce being used in the same manner, as the first juyce was that made the part whereunto this is to be joyned; it cannot choose but become like unto it in substance. And then, there being no other substance between, it is of it self united unto it without any further help.

9. Of Augmentation.

Hitherto this action belongeth to nutrition. But if on the one side, the heat and spirituality of the bloud; and on the other side the due temper and disposition of the part be such, as the bloud is greedily sucked into the part, which thereby swelleth to make room for it, and will not let it go away, but turneth it into a like substance as it self is; and in greater quantity then what is consumed and decayeth continually by transpiration: then this action is called likewise augmentation. Which Galen explicateth by a sport the boyes of Ionia used; who were accustomed to fill a bladder with wind; and when they could force no more into it, they would rub the bladder, and after rubbing of it, they found

found it capable of receiving new breath; and so they would proceed on, untill their bladder were as full as by use they knew it could be made. Now (saith he) nature doth the like, by filling our flesh and other parts with bloud; that is to say, it stretcheth the fibers: but she hath over and above a power which the boyes had not; namely to make the fibers as strong after they are stretched to their utmost extension, as they were before they were extended: whence it happeneth that she can extend them again as well as at the first; and this without end, as far as concerneth that part.

The reason whereof is, because she extendeth them by means of a liquour which is of the same nature, as that whereof they were made at the first: and from thence it followeth, that by concoction that liquour settleth in the parts of the fibers which have most need; and so maketh those parts as great in the length they are extended unto, as they were in their shortnesse before they were drawn out. Whereby the whole part of the animal, wherein this happeneth, groweth greater: and the like being done in every part, as well as in any one single one, the whole animal becometh bigger; and is in such sort augmented.

10. Of death and sicknesse.

Out of all which discourse, we may collect that in the essentiall composition of living creatures, there may peradventure be a physicall possibility for them to continue alwayes without decay; and so become immortall, even in their bodies, if all hurtfull accidents coming from without might be prevented. For seeing that a man, besides the encrease which he maketh of himself, can also impart unto his children a virtue, by which they are able to do the like, and to give again unto theirs as much as they received from their fathers: it is clear, that what maketh him die, is no more the want of any radicall power in him, to encrease or nourish himself; then in fire, it is the want of power to burn, which maketh it go out. But it must be some accidentall want, which Galen attributeth chiefly to the drinesse of our bones, and sinews, &c. as you may in him see more at large; for drinesse with density alloweth not easie admittance unto moysture: and therefore it causeth the heat which is in the dry body, either to evaporate, or to be extinguished: and want of heat is that from whence the failing of life proceeth

eth: which he thinketh cannot be prevented by any art or industry.

And herein God hath expressed his great mercy and goodnesse towards us: for seeing that by the corruption of our own nature, we are so immersed in flesh and bloud, as we should for ever delight to wallow in their mire, without raising our thoughts at any time above that low and brutall condition: he hath engaged us by a happy necessity, to think of and to provide for a nobler and farre more excellent state of living that will never change or end.

In pursuance of which inevitable ordinance, man (as if he were grown weary and out of love with this life, and scorned any term in his farm here, since he cannot purchase the fee-simple of it) hasteneth on his death by his unwary and rash use of meats, which poyson his bloud: and then his infected bloud passing through his whole body, must needs in like manner taint it all at once. For the redresse of which mischief, the assistance of physick is made use of: and that passing likewise the same way, purifieth the bloud, and recovereth the corruption occasioned by the peccant humour; or other whiles gathering it together, it thrusteth and carrieth out that evill guest, by the passages contrived by nature to disburden the body of unprofitable or hurtfull superfluities.

## CHAP. XXVII.

### *Of the motions of sense; and of the sensible qualities in generall; and in particular, of those which belong to Touch, Taste, and Smelling.*

1. The connexion of the subsequent chapters with the precedent.

HAving thus brought on the course of nature as high as living creatures (whose chief species or division is those that have sense) and having declared the operations which are common to the whole tribe of them which includeth both plants and animals; it is now time we take a particular view of those, whose action and passion is the reason why that chief portion of life is termed sensitive; I mean the senses, and the qualities, by which the outward world cometh into the living creature through his senses. Which when we shall have gone through, we

we shall scarcely have left any qualities among bodies, to plead for a spirituall manner of being or working; that is, for a self-entity, and instantaneous operation: which kind of things and properties, vulgar Philosophy is very earnest to attribute unto our senses: with what reason, and upon what ground let us now consider.

2. Of the senses & sensible qualities in generall. And of the end for which they serve.

These qualities are reduced to five severall heads, answerable to so many different wayes, whereby we receive notice of the bodies that are without us. And accordingly, they constitute a like number of different senses: of every one of which, we will discourse particularly, when we have examined the natures of the qualities that affect them. But now, all the consideration we shall need to have of them, is onely this; That it is manifest the organes in us, by which sensible qualities do work upon us, are coporeall, and are made of the like ingredients as the rest of our body is: and therefore must of necessity be liable to suffer evil and to receive good (in such sort as all other bodies do) from those active qualities which make and marre all things within the limits of nature. By which terms of Evill and Good, I mean those effects that are averse or conformable to the particular nature of any thing; and thereby do tend to the preservation or destruction of that individuall.

Now we receiving from our senses the knowledge that we have of things without us, do give names unto them according to the passions and affections which those things cause in our senses: which being the same in all mankind (as long as they are considered in common, and that their effects are looked upon in grosse) all the world agreeth in one notion, and in one name of the same thing; for every man living is affected by it, just as his neighbour is, and as all men else in the world are. As for example, heat or cold worketh the same feeling in every man composed of flesh and bloud; and therefore whosoever should be asked of them would return the same answer, that they cause such and such effects in his sense, pleasing or displeasing to him, according to their degrees, and as they tend to the good or evill of his whole body.

But if we descend to particulars, we shall find that severall men of differing constitutions do frame different notions of the same

same things, according as they are conformable or disagreeing to their natures: and accordingly they give them different names. As when the same liquour is sweet to some mens taste, which to anothers appeareth bitter: one man taketh that for a perfume, which to another is an offensive smell: in the Turkish baths; (where there are many degrees of heat in divers rooms, through all which the same person useth to passe, and to stay a while in every one of them, both at his entrance and going out, to season his body by degrees, for the contrary excesse he is going unto) that seemeth chilly cold at his return; which appeared melting hot at his going in; as I my self have often made experience in those countreys. Beauty and lovelinesse will shine to one man in the same face, that will give aversion to another. All which proclaimeth, that the sensible qualities of bodies are not any positive reall thing consisting in an indivisible, and distinct from the body it self; but are merely the very body, as it affecteth our senses: which to discover how they do it, must be our labour here.

Let us therefore begin with considering the difference that is between sensible & insensible creatures. These latter do lie exposed to the mercy of all outward agents that from time to time (by the continuall motion which all things are in) do come within distance of working upon them: and they have no power to remove themselves from what is averse to their nature; nor to approch nearer unto what comforteth it. But the others having within themselves a principle of motion (as we have already declared) whensoever such effects are wrought upon them, as upon the others; they are able upon their own account and by their own action, to remove themselves from what beginneth to annoy them, and to come nearer unto what they find a beginning of good by.

These impressions are made upon those parts of us, which we call the organs of our senses; and by them do give us seasonable advertisements and knowledges whereby we may govern and order to the best advantage, our little charge of a body, according to the tune or warnings of change in the great circumstant body of the world, as far as it may concern ours. Which how it is done, and by what steps it proceedeth, shall be in the following discourse laid open.

Of this great machine that environeth us, we who are but a small parcell, are not immediately concerned in every part of it. It importeth not us for the conservation of our body, to have knowledge of other parts then such as are within the distance of working upon us: those onely within whose sphere of activity we are planted, can offend or advantage us: and of them some are near us, others further from us. Those that are next unto us, we discern (according as they are qualified) either by our touch, or by our taste, or by our smelling; which three senses do manifestly appear to consist in a mere gradation of more or lesse grosse; and their operations are levelled to the three elements that presse upon us, earth, water, and aire. By our other two senses (our hearing and our seeing) we have notice of things further off: and the agents which work upon them, are of a more refined nature.

3. Of the sense of touching: and that both it & its qualities are bodies.

But we must treat of them all in particular: and that which we will begin with shall be the touch, as being the grosseſt of them, and that which converseth with none but the most materiall and massie objects. We see it dealeth with heavie consistent bodies, and judgeth of them by conjunction unto them, and by immediate reception of something from them. And according to the divers impressions they make in it, it distinguisheth them by divers names; which (as we said of the qualities of mixed bodies) are generally reduced to certain pairs, as hot and cold, wet and dry, soft and hard, smooth and rough, thick and thinne, & some others of the like nature; which we needlesse to enumerate, since we pretend not to deliver the science of them, but onely to shew that they and their actions are all corporeall.

And this is sufficiently evident, by mere repeating but their very names: for it is plain by what we have already said, that they are nothing else but certain affections of quantity, arising out of different degrees of rarity and density compounded together. And it is manifest by experience, that our sense receiveth the very same impressions from them which another body doth: for our body or our sense will be heated by fire; and will also be burned by it, if the heat be too great as well as wood: it will be constipated by cold water, moystened by humide things, and dryed by dry bodies, in the same manner as any other body what-

whatsoever; likewise, it may in such sort as they be wounded and have its continuity broken by hard things; be pleased and polished by those that are soft and smooth; be pressed by those that are thick and heavie; and be rubbed by those that are rugged, &c.

So that those masters who will teach us that the impressions upon sense are made by spirituall or spirit-like things or qualities, which they call intentionall species, must labour at two works: the one to make it appear that there are in nature such things as they would perswade us; the other, to prove that these materiall actions we speak of are not able to perform those effects, for which the senses are given unto living creatures. And untill they have done that, I conceive we should be much too blame to admit such things, as we neither have ground for in reason, nor can understand what they are. And therefore we must resolve to rest in this belief, which experience breedeth in us; that these bodies work upon our senses no other wayes then by a corporeall operation; and that such a one is sufficient for all the effects we see proceed from them: as in the processe of this discourse we shall more amply declare.

4. Of the taste and its qualities: that they are bodies.

The element immediately next to earth in grosseness, is water. And in it is the exercise of our taste, our mouth being perpetually wet within; by means of which moysture, our tongue receiveth into it some little parts of the substance which we chew in our teeth, and which passeth over it. You may observe how, if we take any herb or fruit, and having chopped or beaten it small, we then put it into a wooden dish of water and do squeeze it a little; the juyce communicating and mingling it self with the water, infecteth it with the taste of it self, and remaining a while in the bowl, sinketh by little and little into the very pores of the wood: as is manifest by its retaining a long time after the taste and smell of that herb. In like manner, nature hath taught us by chewing our meat, and by turning it into our mouthes and presing it a little (that we may the more easily swallow it) to imbue our spittle with such little parts as easily diffuse themselves in water. And then our spittle being continuate to the moysture which is within our tongue, (in such sort as we declared of the moysture of the earth that soaketh into the

root of a plant ) and particularly in the sinews of it; must of necessity affect those little sensible strings with the qualities which these petty bodies, mixed every where with the moisture, are themselves imbued withall.

And if you ask what motions or qualities these be: Physicians (unto whom it belongeth most particularly to look into them ) will tell you, that some dilate the tongue more, and some lesse; as if some of these little bodies had an aereall, and others a watry disposition: and these two they expresse by the names of sweet and fatty. That some do contract and draw the tongue together, as choaky and rough things do most; and next to them crabby and immature sharpnesse. That some do corrode and pierce the tongue, as salt and sowre things. That bitter things do search the outside of it, as if they swept it: and that other things do as it were prick it, as spices and hot drinks. Novv all these are sensible materiall things, vvhich admit to be explicated clearly, by the varieties of rarity and density concurring to their compositions; and are so proportionable to such materiall instruments as vve cannot doubt but that they may be throughly declared by our former principles.

5. That the smell and its qualities are reall bodies.

The next element above water is aire, vvhich our nostrills, being our instrument to suck in, vve cannot doubt but what affecteth a man by his nose, must come unto him in breath or aire. And as humidity receiveth grosser and weightier parts, so those which are more subtile and light, do rise up into the aire: and these we know attain unto this lightnesse by the commixtion of fire, which is hot and dry. And therefore we cannot doubt, but that the nature of smell is more or lesse tending to heat and drought: which is the cause that their commixtion with the brain, proveth comfortable unto it; because of its own disposition it is usually subject to be too moist and too cold.

Whether there be any immediate instrument of this sense, to receive the passion or effect, which by it other bodies make upon us; or whether the sense it self be nothing but a passage of these exhalations and little bodies unto the brain, fitly accommodated to discern what is good or hurtfull for it, and accordingly to move the body to admit or reject them, importeth not

not us at present to determine: let Physicians and Anatomists resolve that question, whiles it sufficeth us to understand that the operations of bodies by odours upon our sense, are performed by reall & solide parts of the whole substance; which are truly materiall, though very little bodies; and not by imaginary qualities.

6. Of the conformity betwixt the two senses of smelling and tasting.

And those bodies, when they proceed out of the same things that yield also tastive particles, (although without such materiall violence, & in a more subtile manner) must of necessity have in them the same nature, which those have that affect the taste; and they must both of them affect a man much alike, by his taste and by his smell: and so are very proportionate to one another; excepting in those properties which require more cold or liquidity then can well stand with the nature of a smell. And accordingly, the very names which men have imposed to expresse the affections of both, do many times agree: as savour, which is common both to the smell and to the taste; and sweet likewise: the strongest of which we see oftentimes do make themselves known as well by the one as by the other sense; and either of them in excesse will turn a mans stomack. And the Physicians that write of these senses find them very conformable: and therefore it happeneth that the losing of one of them, is the losse also of the other.

And experience teacheth us in all beasts, that the smell is given unto living creatures, to know what meats are good for them, and what are not. And accordingly we see them still smell for the most part at any unknown meat before they touch it; which seldome faileth of informing them rightly: nature having provided this remedy against the gluttony, which could not choose but follow the convenient disposition and temper of their parts and humours; through which they often swallow their meat greedily and suddenly, without expecting to try it first by their taste. Besides that, many meats are so strong, that their very tasting them after their usuall manner, would poyson or at the least greatly annoy them: and therefore nature hath provided this sense to prevent their taste; which being far more subtile then their taste; the small atomes by which it is performed are not so very noxious to the health of the animal, as the other grosser atomes are.

7. The reason why the sense of smelling is not so perfect in man as in beasts: with a wonderfull history of a man who could wind a sent as well as any beast.

And doubtlessely, the like use men would make of this sense, had they not on the one side better means then it to know the qualities of meats: and therefore, this is not much reflected upon. And on the other side, were they not continually stuffed and clogged with grosse vapours of steamy meats, which are dayly reeking from the table and their stomacks; and permit not purer atomes of bodies, to be discerned; which require cleare and uninfected organes to take notice of them. As we see it fare with dogges; who have not so true and sensible noses, when they are high fed, and lie in the kitchin amidst the steams of meat; as when they are kept in their kennell, with a more spare diet, fit for hunting.

One full example, this age affordeth us in this kind, of a man whose extremity of fear, wrought upon him to give us this experiment. He was born in some village of the countrey of Liege: and therefore among strangers, he is known by the name of John of Liege. I have been informed of this story by severall (whom I dare confidently beleeve) that have had it from his own mouth, and have questioned him with great curiosity, particularly about it.

When he was a little boy, there being warres in the countrey (as that State is seldome without molestations from abroad, when they have no distempers at home, which is an unseparable effect of a countries situation upon the frontiers of powerfull neighbouring Princes that are at variance) the village of whence he was, had notice of some unruly scattered troups that were coming to pillage them: which made all the people of the village flie hastily with what they could carry with them, to hide themselves in the woods: which were spacious enough to afford them shelter, for they joyned upon the forrest of Ardenne. There they lay, till some of their scouts brought them word, that the souldiers of whom they were in such apprehension had fired their town and quitted it. Then all of them returned home, excepting this boy; who, it seemeth, being of a very timorous nature, had images of fear so strong in his phansie; that first, he ran further into the wood then any of the rest; and afterwards apprehended that every body he saw through the thickets, and every voice he heard was the souldiers: and so hid himself from his

his parents that were in much distresse seeking him all about, and calling his name as loud as they could. When they had spent a day or two in vain, they returned home without him, and he lived many years in the woods, feeding upon roots, and wild fruits, and maste.

He said that after he had been some time in this wild habitation, he could by the smell judge of the tast of any thing that was to be eaten: and that he could at a great distance wind by his nose, where wholesome fruits or roots did grow. In this state he continued (still shunning men with as great fear as when he first ranne away; so strong the impression was, and so little could his little reason master it) untill in a very sharp winter, that many beasts of the forrest perished for want of food; necessity brought him to so much confidence, that leaving the wild places of the forrest, remote from all peoples dwellings, he would in the evenings steal among cattle that were fothered; especially the swine, and among them, glean that which served to sustain wretchedly his miserable life. He could not do this so cunningly, but that returning often to it, he was upon a time espied: and they who saw a beast of so strange a shape (for such they took him to be, he being naked and all overgrown with hair) believing him to be a satyre, or some such prodigious creature as the recounters of rare accidents tell us of; laid wait to apprehend him. But he that winded them as farre off, as any beast could do, still avoided them, till at the length, they laid snares for him, and took the wind so advantagiously of him, that they caught him: and then, soon perceived he was a man; though he had quite forgotten the use of all language: but by his gestures and cries, he expressed the greatest affrightednesse that might be. Which afterwards he said (when he had learned anew to speak) was because he thought, those were the souldiers he had hidden himself to avoid, when he first betook himself to the wood; and were alwayes lively in his phansie, through his fears continually reducing them thither.

This man within a little while after he came to good keeping and full feeding, quite lost that acuteness of smelling which formerly governed him in his taste; and grew to be in that particular as other ordinary men were. But at his first living with other

other people, a woman that had compassion of him to see a man so near like a beast; and that had no language to call for what he wished or needed to have; took particular care of him; and was alwayes very sollicitous to see him furnished with what he wanted: which made him so apply himself unto her in all his occurrents, that whensoever he stood in need of ought, if she were out of the way, and were gone abroad into the fields, or to any other village near by, he would hunt her out presently by his sent, in such sort as with us those dogs use to do which are taught to draw dry foot. I imagine he is yet alive to tell a better story of himself then I have done; and to confirm what I have here said of him: for I have from them who saw him but few years agone, that he was an able strong man, and likely to last yet a good while longer.

And of another man, I can speak assuredly my self, who being of a very temperate or rather spare diet, could likewise perfectly discern by his smell the qualities of whatsoever was afterwards to passe the examination of his taste, even to his bread and bear. Wherefore to conclude, it is evident both by reason, and by experience, that the objects of our touch, our taste, and our smell, are materiall and corporeall things, derived from the division of quantity, into more rare and more dense parts; and may with ease be resolved into their heads and springs sufficiently to content any judicious and rationall man. Who if he be curious to have further satisfaction in this particular (as farre as concerneth odours and savours) may look over what Joannes Bravus (that judicious, though unpolished Physitian of Salamanca) hath written thereof.

CHAP.

## THE EIGHT AND TWENTIETH CHAPTER,

### *Of the sense of hearing, and of the sensible quality sound.*

1 Of the sense of hearing: and that sound is purely motion.

BUt to proceed with the rest of the senses: because nature saw that some things came suddenly upon a living creature; which might do it hurt, if they were not perceived afar off: and that other things were placed at distance from it, which would greatly helpe it, if it could come neere unto them; she found a meanes to give us two senses more, for the discovery of remote things. The one principally and particularly to descry their motion. The other to marke their bulke and situation.

And so to begin with the former of these; we must needs acknowledge (after due examination of the matter) that the thing which we call sound is purely motion. And if it be objected that many motions are made without any discernable sound: We shall not make difficulty to grant it; considering that many motions die, before they come to touch the eare; or else are so weake, that they are drowned by other stronger motions, which round about besiege our eares in such manner, that notice is not taken of these: for so it fareth in what dependeth meerely of quantity, especially, concerning our senses, that not every thing of the kind, but a terminate quantity or multitude of parts of it, maketh an object sensible.

But to come close to the point; we see that sound, for the most part, is made in the ayre; and that to produce it, there is required a quicke and smart motion of that Element, which, of all the rest, is the most moveable. And in motion, velocity or quickness, is proportionate to density in magnitude (as we have at large declared.) Which maketh quantity become perceptible in bulke, as this doth in motion. And as the one consisteth in a greater proportion of substance to the same quantity; so the other doth in the passage of more parts of the medium in the same time.

And in the moderating of this, such of the liberall Arts are employed, which belong to the cultivating mans voyce; as Rhetoricke, meetering, and singing. It is admirable how finely Ga-

2. Of divers arts belonging to the sense of hearing: all which confirm that sound is nothing but motion.

lileo hath delivered us the consonances of Musicke towards the end of his first Dialogue of motion; from the 95 page forward on: and how he hath shewed that matter cleerely unto the sight (so making the eye as well as the eare judge of it) in motions of the water, in pendants hanging loose in the ayre, and in permanent notes or races made upon setton. To the moderation of the same, many other mechanicall arts are applied; as the trade of bellfounders; and of all makers of musicall instruments by wind, or by water, or by strings.

Neither can I slip over without mentioning the two curious arts of Echoing and of Whispering. The first of which, teacheth to iterate voyces severall times; and is frequently put in practise by those that are delighted with rarities in their gardens. And the other, sheweth how to gather into a narrow roome the motions of the ayre, that are diffused in a great extent; whereby, one that shall put his eare to that place, where all the severall motions doe meet, shall heare what is spoken so low, as no body between him, and the speaker, can discerne any sound at all. Of which kind, there are very fine curiosities in some Churches of England: and my selfe have seen, in an upper room of a capacious round Tower vaulted overhead, the walls so contrived (by chance I beleeve) that two men standing at the utmost opposite points of the Diameter of it, could talke very currently and cleerely with one and other; and yet none that stood in the middle could heare a syllable. And if he turned his face to the wall and spoke against that (though never so softly) the others eare, at the opposite point, would discerne every word. Which putteth me in mind of a note made by one that was no friend to auricular confession; upon his occasion of his being with me in a Church that had been of a Monastery; where, in one corner of it, one might sit and heare almost all that was whispered through the whole extent of the Church: who would not be perswaded but that it was on purpose contrived so by the subtilty of the Friars; to the end that the Prior or some one of them, might sit there and heare whatsoever the severall Penitents accused themselves of to their ghostly fathers; so to make advantage by this artifice, of what the confessors durst not of themselves immediately reveale?

He allowed better of the use in Rome of making voyces rebound

bound from the top of the cupula of St. Peters in the Vatican, down to the floore of the Church; when on great daies they make a Quire of Muſike goe up to the very higheſt part of the arch, which is, into the Lanthorne: from whence while they ſing, the people below juſt under it are ſurpriſed with the ſmart ſound of their voices, as though they ſtood cloſe by them, and yet can ſee no body from whom thoſe notes ſhould proceed. And in the ſame cupula, if two men ſtand upon the large corniſh or bord, which circleth the bottom of it, they may obſerve the like effect, as that which I ſpoke of above in the round Tower.

In the like manner, they that are called ventriloqui, do perſwade ignorant people, that the divel ſpeaketh from within them (deep in their belly) by their ſucking their breath inwards in a certaine manner whiles they ſpeake: whence it followeth that their voice ſeemeth to come not from them, but from ſomewhat elſe hidden within them; if (at the leaſt) you perceive it commeth out of them: but if you do not, then it ſeemeth to come from a good way off.

To this art belongeth the making of Sarabatanes or Trunks, to helpe the hearing; and of Echo glaſſes, that multiply ſounds, as burning-glaſſes do light. All which arts, and the rules of them, do follow the laws of motion; and every effect of them is to be demonſtrated by the principles and proportions of motion: and therefore, we cannot with reaſon imagine them to be any thing elſe.

3 The ſame is confirmed by the effects cauſed by great noiſes.

We ſee likewiſe, that great noiſes, not only offend the hearing, but even ſhake houſes and Towers. I have been told by inhabitants of Dover, that when the Arch-Duke Albertus made his great battery againſt Calais (which for the time was a very furious one; for he endeavored all he could to take the Town before it could be relieved) the very houſes were ſhaken, and the glaſſe-windows were ſhivered, with the report of his Artillery. And I have been told by one that was in Sevill, when the gunpowder-houſe of that towne (which was ſome two miles diſtant from that place where he lived) was blown up, that it made the wooden ſhutters of the windows in his houſe, beat and clap againſt the walls with great violence, and did ſplit the very walls of a faire Church, that ſtanding next it (though at a good diſtance) had no other building betweene to ſhelter it from the impetuo-

impetuosity of the ayres sudden violent motion.

And after a fight I once had with some Galleasses and Galliones in the rode of Scanderone (which was a very hot one for the time, and a scarce credible number of pieces of Ordnance were shot from my fleete) the English Consull of that place comming afterwards abord my ship, told me that the report of our guns had during all the time of the fight shaken the drinking-glasses that stood upon shelves in his house; and had split the paper-windows all about; and had spoiled and cracked all the egges that his Pigeons were then sitting upon: which losse, he lamented exceedingly; for they were of that kind, which commonly is called *Carriers*, and serve them daily in their commerce between that place and Aleppo.

And I have often observed at sea, in smooth water, that the ordnance shot of in a ship some miles distant, would violently shake the glasse windows in another. And I have perceived this effect in my owne, more then once, at the report of a single gun from a ship so far off, that we could not descry her. I remember how one time upon such an occasion, we altered our course and steared with the sound, or rather with the motion at the first, observing upon which point of the Compasse the shaking appeared (for as we heard nothing; though soon after with much attention and silence we could discerne a dull clumsie noise: and such a motion groweth at the end of it so faint, that if any strong resisting body checke it in its course, it is presently deaded, and will afterwards shake nothing beyond that body: and therefore it is perceptible onely at the outside of the ship, if some light and very moveable body do hang loosely on that side it cometh, to receive the impression of it; as this did at the gallery windows of my cabin upon the poope, which were of light Moscovia glasse or talk:) and by then we had run somewhat more then a watch, with all the sails abroad we could make, & in a fair loom gale, we found our selves neere enough to part the fray of two ships, that in a little while longer fighting would have sunk one another.

4. That solid bodies may convey the motion of the ayre or sound to the organe of hearing.

But besides the motions in the ayre (which received them easily by reason of the fluidity of it) we see that even solide bodies do participate of it. As if you knock never so lightly at one end of the longest beam you can find, it will be distinctly hard at the other end: the trampling of men and horses in a quiet night will

be

be heard some miles off, if one lay their eare to the ground; and more sensibly if one make a little hole in the earth, and put ones eare into the mouth of it; but most of all if one set a Drum smooth upon the ground, and lay ones eare to the upper edge of it; for the lower membrane of the Drum is shaked by the motion of the earth, and them multiplyeth that sound by the hollow figure of the Drum in the conveying it to the upper membrane, upon which your eare leaneth. Not much unlike the tympane or drum of the eare; which being shaked by outward motion, causeth a second motion on the inside of it correspondent to this first; and this having a free passage to the braine, striketh it immediately and so informeth it how things move without; which is all the mystery of hearing.

If any thing doe breake or stop this motion, before it shake our eare, it is not heard. And accordingly we see that the sound of bells or artillery is heard much further if it have the conduct of waters, then through the pure ayre: because in such bodies the great continuity of them maketh that one part cannot shake alone, and upon their superficies, there is no notable unevenesse, nor no dense thing in the way to checke the motion (as in the ayre, hils, buildings, trees, and such like:) so that the same shaking goeth a great way. And to confirme that this is the true reason, I have severall times observed, that standing by a river side, I have heard the sound of a ring of bells, much more distinctly and lowd, then if I went some distance from the water, though neerer to the steeple from whence the sound came.

5. Where the motion is interrupted there is no sound.

And it is not only the motion of the ayre, that maketh sound in our eares: but any motion that hath accesse to them in such a manner as to shake the quivering membranous tympane within them, will represent unto us those motions which are without, and so make such a sound there as if it were conveyed onely by the ayre. Which is plainely seen, when a man lying a good way under water, shall there heare the same sounds, as are made above in the ayre; but in a more clumsie manner; according as the water, by being thicker, and more corpulent is more unwieldy in its motions. And this I have tried often; staying under water as long as the necessity of breathing would permit me. Which sheweth that the ayre being smartly moved, moveth the water also, by meanes of its continuity with it; and that liquid

6. That not onely the motion of the ayre, but all other motions comming to our eares make sounds.

quid element, being fluide and getting into the eare, maketh vibrations upon the drum of it like unto those of ayre.

7. How one sense may supply the want of an other.

But all this is nothing in respect of what I might in some sort say, and yet speake truth. Which is, that I have seene one, who could discerne sounds with his eyes. It is admirable, how one sense will oftentimes supply the want of an other: whereof I have seene an other strange example in a different straine from this; of a man that by his grosser senses had his want of sight wonderfully made up. He was so throughly blind, that his eyes could not informe him when the Sunne shined; for all the crystalline humour was out in both his eyes: yet his other senses instructed him so efficaciously in what was their office to have done; as what he wanted in them, seemed to be overpayed in other abilities. To say that he would play at cards and tables as well as most men, is rather a commendation of his memory and fansie, then of any of his outward senses. But that he should play well at boules and shovebord, and other games of ayme, which in other men doe require cleare sight, and an exact levell of the hand according to the qualities of the earth or table, and to the situation and distance of the place he was to throw at, seemeth to exceed possibility: and yet he did all this.

He would walke in a chamber or long alley in a garden (after he had been a while used to them) as straight, and turne as just at the ends, as any seeing man could doe. He would goe up and downe every where so confidently, and demeane himselfe at table so regularly, as strangers have sitten by him severall meales and have seen him walke about the house, without ever observing any want of seeing in him: which he endeavoured what he could to hide, by wearing his hat low upon his browes. He would, at the first abord of a stranger, as soone as he spoke to him, frame a right apprehension of his stature, bulke and manner of making. And which is more, when he taught his schollers to declame (for he was schoolmaster to my sonnes, and lived in my house) or to represent some of Seneca's Tragedies, or the like, he would by their voyce know their gesture, and the situation they put their bodies in: so that he would be able, as soon as they spoke, to judge whether they stood or sate, or in what posture they were; which made them demeane themselves as decently before him whiles they spoke, as if he had seen them perfectly.

Though

Though all this be very strange, yet me thinks his discerning of light is beyond it all. He would feele in his body, and chiefly in his braine (as he hath often told me) a certaine heat by which he did know when the Sunne was up; and would discern exactly a cleare from a cloudy day. This I have known him frequently doe without missing, when for triall sake he hath been lodged in a close chamber, whereunto the cleare light or Sunne could not arrive to give him any notice by its actuall warmth; nor any body could come to him, to give him private warnings of the changes of the weather.

8. Of one who could discerne sounds of words with his eyes.

But this is not the relation I intended, when I mentioned one that could heare by his eyes; (if that expression may be permitted me) I then reflected upon a Noble man of great quality that I knew in Spaine, the younger brother of the Constable of Castile. But the reflection of his seeing of words, called into my remembrance the other that felt light: in whom I have often remarked so many strange passages, with amazement and delight; that I have adventured upon the Readers patience to record some of them, conceiving they may be of some use in our course of doctrine. But the Spanish Lord was born deafe; so deafe, that if a Gun were shot off close by his eare, he could not heare it: and consequently, he was dumbe, for not being able to heare the sound of words, he could never imitate nor understand them. The lovelinesse of his face, and especially the exceeding life and spiritfulnesse of his eyes, and the comelinesse of his person and whole composure of his body throughout, were pregnant signes of a well tempered mind within. And therefore all that knew him, lamented much the want of meanes to cultivate it, and to imbrue it with the notions which it seemed to be capable of in regard of its selfe; had it not been so crossed by this unhappy accident. Which to remedy Physitians and Chirurgians had long imployed their skill; but all in vaine. At the last, there was a Priest who undertooke the teaching him to understand others when they spoke, and to speake himselfe that others might understand him. What at the first he was laught at for, made him after some yeeres be looked upon as if he had wrought a miracle. In a word, after strange patience, constancy and paines, he brought the young Lord to speake as distinctly as any man whosoever; and to understand so perfectly what

others ſaid that he would not loſe a word in a whole daies converſation.

They who have a curioſity to ſee by what ſteps the maſter proceeded in teaching him, may ſatisfie it by a booke which he himſelf hath writ in Spaniſh upon that ſubject, to inſtruct others how to teach deafe and dumbe perſons to ſpeake. Which when he ſhall have looked heedfully over; and ſhall have conſidered what a great diſtance there is betweene the ſimplicity and nakedneſſe of his firſt principles; and the ſtrange readineſſe and vaſt extent of ſpeech reſulting in proceſſe of time out of them; he will forbeare pronouncing an impoſſibility in their pedegree, whiles he wondreth at the numerous effects reſulting in bodies out of rarity and denſity, ingeniouſly mingled together by an all knowing Architect, for the production of various qualities among mixts, of ſtrange motions in particular bodies, and of admirable operations of life and ſenſe among vegerables and animals. All which are ſo many ſeverall words of the myſticall language, which the great maſter hath taught his otherwiſe dumbe ſchollers (the creatures) to proclaime his infinite art, wiſdome, perfections, and excellency in.

The Prieſt who by his booke and art occaſioned this diſcourſe, I am told is ſtill alive, and in the ſervice of the Prince of Carignan, where he continueth (with ſome that have need of his paines) the ſame imployment as he did with the Conſtables brother: with whom I have often diſcourſed, whiles I waited upon the Prince of Wales (now our gracious Soveraigne) in Spaine. And I doubt not but His Majeſty remembreth all I have ſaid of him and much more: for His Majeſty was very curious to obſerve and enquire into the utmoſt of it. It is true, one great misbecomingneſſe he was apt to fall into, whiles he ſpoke: which was an uncertainty in the tone of his voyce; for not hearing the ſound he made when he ſpoke, he could not ſteddily governe the pitch of his voyce; but it would be ſometimes higher, ſometimes lower; though for the moſt part, what he delivered together, he ended in the ſame key as he begun it. But when he had once ſuffered the paſſage of his voice to cloſe, at the opening them againe, chance, or the meaſure of his earneſtneſſe to ſpeake or to reply, gave him his tone: which he was not capable of moderating by ſuch an artifice, as is recorded Caius Gracchus uſed,

when

when passion, in his orations to the people, drove out his voyce with too great a vehemence or shrilnesse.

He could discerne in another, whether he spoke shrill or low: and he would repeate after any body, any hard word whatsoever. Which the Prince tryed often; not onely in English, but by making some Welchmen that served his Highnesse, speake words of their language. Which he so perfectly ecchoed, that I confesse I wondered more at that, then at all the rest. And his Master himselfe would acknowledge, that the rules of his art reached not to produce that effect with any certainty. And therefore concluded, this in him must spring from other rules he had framed unto himselfe, out of his own attentive observation: which, the advantage that nature had justly given him in the sharpenesse of his other senses, to supply the want of this; endowed him with an ability and sagacity to do, beyond any other man that had his hearing. He expressed it (surely) in a high measure, by his so exact imitation of the Welch pronunciation: for that tongue (like the Hebrew) employeth much the gutturall Letters: and the motions of that part which frameth them, cannot be seene nor judged by the eye, otherwise then by the effect they may happily make by consent in the other parts of the mouth, exposed to view: for the knowledge hee had of what they said, sprung from his observing the motions they made; so that hee could converse currently in the light, though they he talked with, whispered never so softly. And I have seene him at the distance of a large chambers breadth, say words after one, that I standing close by the speaker could not heare a syllable of. But if he were in the darke, or if one turned his face out of his sight, he was capable of nothing one said.

But it is time that we returne to our theame, from whence my blind Schoolemaster, and this deafe Prince (whose defects were overpayed an other way) have carried us with so long a digression. Which yet will not be altogether useless (no more then the former, of the wild man of Liege) if wee make due reflections upon them: for when we shall consider, that odors may be tasted; that the relish of meates may be smelled; that magnitude and figure may be heard; that light may be felt; and that sounds may be seen; (all which is true in some sense) we may by this changing the offices of the senses, and by looking into

9. Divers reasons to prove sound to be nothing else but a motion of some reall body.

into the causes thereof; come to discerne that these effects are not wrought by the intervention of ayery qualities; but by reall and materiall applications of bodies to bodies; which in different manners do make the same results within us.

But when I suffered my pen to bee steered by my fansie, that pleased it selfe, and rioted in the remembrance of these two notable persons: I was speaking, how the strong continuity of the parts of a thing that is moved, draweth on the motion, and consequently the sound, much further then where that which is moved suffereth breaches, or the rarity of it occasioneth that one part may be moved without an other; for to the proportion of the shaking, the noise continueth. As we see in trembling bells, that hum a great while longer then others, after the Clapper hath strucken them: and the very sound seemeth to quiver and shake in our eares, proportionable to the shaking of the bell. And in a Lute as long as a string that hath been strucken, shaketh sensibly to our eye; so long, and to the same measure, the sound shaketh in our eare. Which is nothing else but an undulation of the Ayre, caused by the smart and thick vibrations of the corde, and multiplyed in the belly of the instrument (which is the reason that the concave figure is affected in most) and so when it breaketh out of the instrument in greater quantity, then the string immediately did shake; it causeth the same undulations in the whole body of Ayre round about. And that, striking the Drum of the eare, giveth notice therein what tenour the string moveth: whose vibrations if one stop by laying his finger upon it, the sound is instantly at an end, for then there is no cause on foot, that continueth the motion of the Ayre: which, without a continuation of the impulse, returneth speedidily to quiet; through the resistance made unto it, by other parts of it that are further off.

Out of all which it is plaine, that motion alone is able to effect and to give account of all things whatsoever that are attributed to sound; and that sound and motion, do goe hand in hand together; and that whatsoever is said of the one, is likewise true of the other. Wherefore it cannot be denyed but that *hearing* is nothing else but the due perception of *motion*: and that *motion* and *sound* are in themselves one and the same thing, though expressed by different names, and comprised in our understanding

derſtanding under different notions. Which propoſition ſeemeth to be yet further convinced, by the ordinary experience of perceiving muſike by mediation of a ſtick; for how ſhould a deafe man be capable of muſick by holding a ſtick in his teeth, whoſe other end lyeth upon the Viali or Virginalls, were it not that the proportionall ſhaking of the ſtick (working a like dauncing in the mans head) did make a like motion in his braine, without paſſing through his eare? and conſequently, without being otherwiſe *ſound*, then as bare motion is *ſound*.

Or if any man will ſtill perſiſt in having ſound be ſome other thing then as wee ſay; and that it affecteth the ſenſe otherwiſe then purely by motion: hee muſt nevertheleſſe acknowledge, that whatſoever it be, it hath neither cauſe nor effect, nor breeding, nor dying, that we either know or can imagaine: and then, if he will let reaſon ſway, hee will conclude it unreaſonable to ſay or ſuſpect ſo ill grounded a ſurmiſe, againſt ſo cleare and ſolid prooſes: which our eares themſelves do not a little confirm; their whole figure and nature tending to the perfect receiving, conſerving, and multiplying the motions of ayre which happen without a man: as who is curious, may plainly ſee in the Anatomiſts books and diſcourſes.

## THE NINE AND TWENTIETH CHAP.

### *Of Sight, and Colours.*

THere is yet left, the object of our ſight; *which we call colours*, to take a ſurvey of; for as for *light*, wee have at large diſplayed the nature and properties of it: from which whether colour be different or no, will be the queſtion we ſhall next diſcuſſe: for thoſe who are cunning in Optikes, will by refractions and by reflexions make all ſorts of colours out of pure light: as we ſee in Rainebowes, in thoſe triangular glaſſes, or priſmes which ſome do call *fooles Paradiſes*, and in other inventions for this purpoſe. Wherefore, in briefe, to ſhew what colour is, let us lay for a ground, that light is of all other things in the world, the greateſt and the moſt powerfull agent upon our eye; either by it ſelfe, or by what commeth in with it: and that,

1. That colours are nothing but light mingled with darkneſſe; or the diſpoſition of a bodies ſuperficies apt to reflect light ſo mingled.

that, where light is not, darkeneſſe is; then conſider, that light being diverſly to bee caſt, but eſpecially, through or from a tranſparent body, into which it ſinketh in part, and in part it doth not: and you will conclude, that it cannot chooſe but come out from ſuch a body, in divers ſorts mingled with darkeneſſe: which if it bee in a ſenſible quantity, doth accordingly make divers appearances: and thoſe appearances muſt of neceſſity have divers hues, repreſenting the colours which are middle colours betweene white and black; ſince white is the colour of light, and darkeneſſe ſeemeth black. Thus, thoſe colours are ingendred, which are called apparent ones. And they appeare ſometimes but in ſome one poſition; as in the rainebow; which changeth place as the looker on doth: but at other times, they may bee ſeen from any part; as thoſe which light maketh by a double refraction through a triangular glaſſe

And that this is rightly delivered, may be gathered out of the conditions requiſite to their production: for that cryſtall, or water, or any refracting body, doth not admit light in all its parts, is evident, by reaſon of the reflection that it maketh, which is exceeding great: and not onely from the ſuperficies, but even from the middle of the body within: as you may ſee plainly, if you put it in a darke place, and enlighten but one part of it: for then, you may perceive, as it were, a current of light paſſe quite through the body, although your eye be not oppoſite to the paſſage: ſo that, manifeſtly it reflecteth to your eye, from all the inward parts which it lighteth upon.

Now a more oblique reflection or refraction doth more diſperſe the light, and admitteth more privations of light in its parts, then a leſſe oblique one: as Galileo hath demonſtrated in the firſt Dialogue of his ſyſteme. Wherefore, a leſſe oblique reflection or refraction, may receive that in quality of light, which a more oblique one maketh appeare mingled with darkeneſſe; and conſequently, the ſame thing will appeare colour in one, which ſheweth it ſelfe plaine light in the other; for the greater the inclination of an angle is, the greater alſo is the diſperſion of the light.

And as colours are made in this ſort, by the medium through which light paſſeth, ſo if we conceive the ſuperficies from which the light reflecteth, to be diverſly ordered in reſpect of reflexi-

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on; it must of necessity follow that it will have a divers lustre and sight: as we see by experience in the necks of Pigeons, and in certaine positions of our eye, in which the light passing through our eye browes, maketh an appearance as though wee saw divers colours streaming from a candle we looke upon. And accordingly we may observe how some things, or rather most, do appeare of a colour more inclining to white, when they are irradiated with a great light, then when they stand in a lesser. And wee see painters heighten their colours, and make them appeare lighter by placing deepe shadowes by them: even so much, that they will make objects appeare neerer and further off, meerly by their mixtion of their colours. Because, objects, the neerer they are, the more strongly and lively they reflect light, and therefore, appeare the clearer, as the others do more dusky.

2. Concerning the disposition of those bodies which produce white or black colours.

Therefore, if wee put the superficies of one body to have a better disposition for the reflection of light, then an other hath; wee cannot but conceive, that such difference in the superficies, must needs beget variety of permanent colours in the bodies. And according as the superficies of the same body, is better, or worse disposed to reflection of light, by polishing, or by compressure together, or the like: so, the same body, remaining the same in substance, will shew it selfe of a different colour. And it being evident that white (which is the chiefest colour) doth reflect most light: and as evident, that blacke reflecteth least light, so that it reflecteth shadowes in lieu of colours (as the Obsidian stone among the Romans doth witnesse.) And it being likewise evident, that to be dense and hard, and of small parts, is the disposition of the object which is most apt to reflect light: wee cannot doubt, but that *white* is that disposition of the superficies. That is to say, it is the superficies of a body consisting of dense, of hard, and of small parts; and on the contrary side, that black is the disposition of the superficies, which is most soft and full of greatest pores; for when light meeteth with such a superficies, it getteth easily into it; and is there, as it were absorpt and hidden in caves, and commeth not out againe to reflect towards our eye.

This doctrine of ours of the generation of colours, agreeth exactly

3. The former doctrine confirmed by Aristotles authority, reason, and experience.

exactly with *Aristotles* principles, and followeth evidently out of his definitions of *light*, and of colours. And for summing up the generall sentiments of mankind in making his Logicall definitions, I thinke no body will deny his being the greatest Master that ever was. Hee defineth light to be *actus Diaphani*: which we may thus explicate. It is that thing, which maketh a body that hath an aptitude or capacity of being seene quite through it in every interior part of it, to be actually seene quite through, according to that capacity of it. And hee defineth colour to be, *The terme or ending of a diaphanous body*: the meaning whereof is: that colour is a thing which maketh a diaphanous body to reach no further; or that colour is the cause why a body is no further diaphanous, then untill where it beginneth or that colour is the reason, why we can see no further then to such a degree, through or into such a body.

Which definition fitteth most exactly with the thing it giveth us the nature of. For it is evident, that when we see a body, the body we see, hindereth us from seeing any other, that is in a straight line beyond it. And therefore it cannot be denyed, but that colour terminateth, and endeth the diaphaneity of a body, by making it selfe be seene. And all men do agree in conceiving this, to be the nature of colour; and that it is a certaine disposition of a body, whereby that body commeth to be seene. On the other side, nothing is more evident, then that to have us see a body, light must reach from that body to our eye. Then adding unto this what Aristotle teacheth concerning the production of seeing: which he sayth is made by the action of the seene body upon our sense: it followeth that the object must worke upon our sense, either by light, or at the least with light; for light rebounding from the object round about by straight lines, some part of it must needs come from the object to our eye. Therefore, by how much an object sendeth more light unto our eye, by so much, that object worketh more upon it.

Now seeing that divers objects do send light in divers manners to our eye, according to the divers natures of those objects in regard of hardnesse, density, and littlenesse of parts: we must agree that such bodies do worke diversly, and do make different motions or impressions upon our eye: and consequently,

ly, the passion of our eye from such objects must be divers. But there is no other diversity of passion in the eye from the object in regard of seeing, but that the object appeare divers to us in point of colour. Therefore we must conclude, that divers bodies (I meane divers or different, in that kind wee here talke of) must necessarily seeme to be of divers colours, meerly by the sending of light unto our eye in divers fashions. Nay, the very same object must appeare of different colours, whensoever it happeneth that it reflecteth light differently to us. As we see in cloth, if it be gathered together in fouldes, the bottomes of those fouldes shew to be of one kind of colour, and the tops of them, or where the cloth is stretched out to the full percussion of light, it appeareth to be of an other much brighter colour. And accordingly painters are faine to use almost opposite colours to expresse them. In like manner if you looke upon two pieces of the same cloth, or plush, whose graines lye contrawise to one an other, they will likewise appeare to be of different colours. Both which accidents, and many others like unto them in begetting various representations of colours; do all of them arise out of lights being more or lesse reflected from one part then from an other.

4. How the diversity of colours do follow out of various degrees of rarity and density.

Thus then you see, how colour is nothing else, but the disposition of a bodies superficies, as it is more or lesse apt to reflect light; hence the reflection of light is made from the superficies of the seen body, and the variety of its reflexion begetteth variety of colours. But a superficies is more or lesse apt to reflect light, according to the degrees of its being more or lesse penetrable by the force of light striking upon it; for those rayes of light that gaine no entrance into a body they are darted upon, must of necessity fly back againe from it. But if light doth get entrance and penetrate into the body, it either passeth quite through it; or else it is swallowed up and lost in that body. The former, constituteth a diaphanous body; as we have already determined. And the semblance which the latter will have in regard of colour, we have also shewed must be black.

But let us proceede a little further. Wee know that two things render a body penetrable, or easie to admit an other body into it. Holes, (such as we call pores) and softnesse or humidity; so that drynesse, hardnesse, and compactednesse, must be the properties

properties which render a body impenetrable. And accordingly we see, that if a diaphanous body (which suffereth light to run through it) be much compressed beyond what it was; as when water is compressed into yce; it becometh more visible, that is, reflecteth more light: and consequently, it becometh more white; for white is that, which reflecteth most light.

On the contrary side, softnesse, unctuousnesse, and viscousnesse, encreaseth blacknesse: as you may experience in oyling or in greasing of wood; which before was but brown, for thereby it commeth more black; by reason that the unctuous parts added unto the other, do more easily then they single, admit into them the light that striketh upon them; and when it is gotten in, it is so entangled there (as though the wings of it were birdlimed over) that it cannot fly out againe. And thus it is evident, how the origine of all colours in bodies, is plainly deduced out of the various degrees of rarity and density, variously mixed and compounded.

5. Why some bodies are Diaphanous, others opacous.

Likewise, out of this discourse, the reason is obvious why some bodies are diaphanous and others are opacous: for sithence it falleth out in the constitution of bodies, that one is composed of greater parts then an other: it must needs happen that light be more hindered in passing through a body composed of bigger parts, then an other whose parts are lesse. Neither doth it import that the pores be supposed as great as the parts, for be they never so large, the corners of the thicke parts they belong unto, must needs break the course of what will not bow, but goeth all in straight lines; more then if the parts and pores were both lesser; since, for so subtile a piercer as light, no pores can be too little to give it entrance. It is true such great ones would better admit a liquid body into them, such a one as water or ayre; but the reason of that is, because they will bow and take any ply, to creep into those cavities, if they be large enough, which light will not do.

Therefore it is cleare, that freedome of passage can happen unto light, only there, where there is an extreme great multitude of pores and parties in a very little quantity or bulke of body (which pores and parts must consequently be extreme little ones) for, by reason of their multitude, there must be great variety in their situation: from whence it will happen that many

many lines muſt be all of pores quite through; and many others all of parts; although the moſt, will be mixed of both pores and parts. And ſo we ſee that although the light do paſſe quite through in many places, yet it reflecteth from more, not onely in the ſuperficies, but in the very body it ſelfe of the Diaphanous ſubſtance. But in an other ſubſtance of great parts, and pores there can be but few whole lines of pores, by which the light may paſſe from the object to make it be ſeene; and conſequently it muſt be opacous; which is the contrary of Diaphanous that admitteth many rayes of light, to paſſe through it from the object to the eye, whereby it is ſeene, though the Diaphanous hard body, do intervene betweene them.

6. The former doctrine of colours confirmed by the generation of white and black in bodies.

Now if wee conſider the generation of theſe two colours (white and black) in bodies; we ſhall find that likewiſe to juſtify and ſecond our doctrine: for white things are generally cold and dry; and therefore, are by nature ordained to be receptacles, and conſervers of heat, and of moyſture; as Phyſitians do note. Contrariwiſe, black, as alſo greene, (which is neere of kinne to black) are growing colours, and are the die of heate incorporated in aboundance of wet: as we ſee in ſmoake, in pitcoale, in garden ground, and in chymicall putrefactions. all which are black; as alſo in yong herbes; which are generally greene as long as they are yong and growing. The other colours, keeping their ſtanding betwixt theſe are generated by the mixture of them; and according as they partake more or leſſe of either of them, are neerer or further off from it.

So that after all this diſcourſe we may conclude in ſhort, that the colour of a body, is nothing elſe, but the power which that body hath of reflecting light unto the eye, in a certaine order and poſition: and conſequently, is nothing elſe but the very ſuperficies of it, with its aſperity, or ſmoothneſſe; with its pores, or inequalities; with its hardneſſe, or ſoftneſſe; and ſuch like. The rules and limits whereof, if they were duly obſerved and ordered the whole nature and ſcience of colours would eaſily be knowne and be deſcribed. But out of this little which we have delivered of this ſubject it may be rightly inferred that reall colours do proceed from rarity and denſity (as even now we touched) and have their head & ſpring there: and are not ſtrange

qualities in the Ayre : but are tractable bodies on the earth, as all others are, which as yet wee have found and have meddied withall : and are indeed, the very bodies themselves causing such effects upon our eye by reflecting of light, which wee expresse by the names of colours.

## THE THIRTIETH CHAP.

### *Of luminous or apparent Colours.*

1. Apparitions of colours through a prisme or triangular glasse are of two sorts,

AS for the luminous colours, whose natures art hath made more maniable by us, then those which are called reall colours, and are permanent in bodies : their generation is cleerely to bee seene in the prisme or triangular glasse wee formerly mentioned. The considering of which, will confirme our doctrine, that even the colours of bodies, are but various mixtures of light and shadowes, diversly reflected to our eyes. For the right understanding of them, wee are to note, that this glasse maketh apparitions of colours in two sorts : the one, when looking through it there appeare various colours in the objects you looke upon (different from their reall ones) according to the position you hold the glasse in when you looke upon them. The other sort is, when the beames of light that passe through the glasse, are as it were tincted in their passage, and are cast by the glasse upon some solid object, and doe appeare there in such and such colours, which doe continue still the same, in what position soever you stand to look upon them; either before, or behind, or on any side of the glasse.

2. The severall parts of the object make severall angles at their entrance into the prisme

Secondly, we are to note that these colours are generally made by refraction (though sometimes it may happen otherwise, as above we have mentioned.) To discover the reason of the first sort of colours, that appeare by refraction when one looketh through the glasse : let us suppose two severall bodies, the one black, the other white, lying close by one an other, and in the same horizontall parallele : but so, that the black be further from us then the white ; then, if we hold the prisme through which we are to see these two oppositely coloured bodies some-

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what above them ; and that ſide of it at which the coloured bodies muſt enter into the glaſſe to come to our eye, parallele unto thoſe bodies ; it is evident, that the black will come into the priſme by leſſer angles then the white : I meane that in the line of diſtance from that face of the glaſſe at which the colours do come in, a longer line or part of black will ſubtend an angle, no bigger then a leſſer line or part of white doth ſubtend.

Thirdly, we are to note, that from the ſame point of the object, there come various beames of light to that whole ſuperficies of the glaſſe ; ſo that it may, and ſometimes doth happen, that from the ſame part of the object, beames may be reflected to the eye, from ſeverall parts of that ſuperficies of the glaſſe at which they enter. And whenſoever this happeneth, the object muſt neceſſarily be ſeene in divers parts : that is, the picture of it will at the ſame time appeare to the eye in divers places. And particularly, we may plainely obſerve two pictures, one a lively and ſtrong one ; the other a faint and dim one. Of which the dim one will appeare neerer us, then the lively one : and is cauſed by a ſecondary ray : or rather I ſhould ſay, by a longer ray, that ſtriking neerer to the hither edge of the glaſſes ſuperficies (which is the furtheſt from the object) maketh a more acute angle then a ſhorter ray doth, that ſtriketh upon a part of the glaſſe further from our eye, but neerer the object. And therefore the image which is made by this ſecondary or longer ray, muſt appeare both neerer and more dusky, then the image made by the primary and ſhorter ray. And the further from the object that the glaſſe through which it reflecteth is ſituated (keeping ſtill in the ſame parallel to the horizon) the further the place where the ſecond dusky picture appeareth, is from the place where the primary ſtrong picture appeareth.

3. The reaſon why ſometimes the ſame object appeareth through the priſme in two places : and in one place more lively, in the other place more dim.

If any man have a mind to ſatisfy himſelfe by experience, of the truth of this note, let him place a ſheet of white paper upon a black carpet covering a table, ſo as the paper may reach within two or three fingers of the edge of the carpet, ( under which, let there be nothing to ſucceed the black of the carpet, but the empty dusky Ayre ) and then let him ſet himſelfe at a convenient diſtance, ( the meaſure of which is, that the paper appeare at his feete, when hee looketh through the glaſſe ) and

looke at the paper through his prisme situated in such sort as we have above determined, and he will perceive a whitish or light-some shadow proceed from the lively picture that he seeth of white, and shoote out neerer towards him then that lively picture is, and he will discerne that it commeth into the glasse through a part of it neerer to his eye or face, and further from the object then the strong image of the white doth. And further, if he causeth the neerer part of the paper to be covered with some thin body of a sadder colour, this dim white vanisheth: which it doth not if the further part of the paper be covered. Whereby it is evident, that it is a secondary image proceeding from the hither part of the paper.

4. The reason of the various colours that appeare in looking through a prisme.

Now then to make use of what we have said to the finding out of the reason why the red and blew and other colours appeare when one looketh through a prisme: let us proceed upon our former example, in which a white paper lyeth upon a black carpet (for, the diametrall opposition of those colours maketh them most remarkable) in such sort that there be a parcell of black on the hither side of the paper: and thereon let us examine according to our grounds, what colours must appeare at both ends of the paper looking upon them through the triangular glasse.

To begin with the furthest end, where the black lyeth beyond the white: we may consider, how there must come from the black, a secondary darke misty shadow (besides the strong black that appeareth beyond the paper) which must shoote towards you (in such sort as we said of the whitish light-some shadow) and consequently, must ly over the strong picture of the white paper: now in this case, a third middling colour must result out of the mixture of these two extremes of black and white; since they come to the eye, almost in the same line, at the least in lines that make so little a difference in their angles as it is not discernable.

The like whereof happeneth in Clothes, or Stuffes, or Stockings, that are woven of divers coloured but very small threds: for you stand so far off from such a piece of Stuffe, that the little threds of different colours which lye immediate to one another may come together as in one line to your eye; it will appeare of a middling colour, different from both those that it resulteth

reſulteth from : but if you ſtand ſo neere that each thred ſendeth rayes enough to your eye, and that the baſis of the triangle which commeth from each thred to your eye, be long enough to make at the vertex of it ( which is in your eye ) an angle big enough to be ſeene ſingly by it ſelfe ; then each colour will appeare a part as it truly is.

Now the various natures of middling colours we may learne of painters ; who compoſe them upon their palettes by a like mixture of the extremes. And they tell us, that if a white colour prevaile ſtrongly over a darke colour, reds and yellowes reſult out of that mixture : but if black prevaile ſtrongly over white, then blewes, violets, and ſeagreenes are made. And accordingly, in our caſe, we cannot doubt but that the primary lively picture of the white, muſt prevaile over the faint dusky ſable mantle with which it commeth mingled to the eye : and doing ſo, it muſt needs make a like appearance as the Sunnes beames do, when reflecting from a black cloud, they fringe the edges of it with red and with yellow ; and the like he doth, when he looketh through a rainy or a windy cloude : and much like hereunto, we ſhall ſee this mixture of ſtrong white with a faint ſhaddow of black, make at this brim of the paper, a faire ledge of red ; which will end and vaniſh, in a more lightſome one of yellow.

But at the hither edge of the paper, where the ſecondary weake picture of white is mingled with the ſtrong black picture, in this mixture, the blacke is prevalent, and accordingly (as we ſaid of the mixture of the painters colours ) there muſt appeare at the bottome of the paper, a Lembe of deepe blew : which will grow more and more lightſome, the higher it goeth : and ſo, paſſing through violet and ſeagreene it will vaniſh in light, when it reacheth to the maſtering field of primary whiteneſſe, that ſendeth his ſtronger rayes by direct lines : and this tranſpoſition of the colours at the ſeverall ends of the paper ſheweth the reaſon why they appeare quite contrary, if you put a black paper upon a white carpet. And therefore, we need not add any thing particularly concerning that.

And likewiſe, out of this we may underſtand, why the colours appeare quite contrary (that is, red where before blew appeared ; and blew, where red ) if wee looke upon the ſame

5. The reason why the prisme in one position, may make the colours appeare quite contrary to what they did, when it was in an other position.

object through the glasse in an other position or situation of it: namely, if we rayse it so high, that we must looke upwards to see the object; which thereby appeareth above us: whereas in the former situation, it came in through the lower superficies, and we looked downe to it, and it appeared under us: for in this second case, the objects comming into the glasse by a superficies not parallel as before, but sloaping, from the objectwards: it followeth, that the neerer the object is, the lesser must the angle be, which it maketh with the superficies; contrary to what happened in the former case: and likewise, that if from one point of the neerer object, there fall two rayes upon the glasse, the ray that falleth uppermost, will make a lesser angle, then the other that falleth lower: and so, by our former discourse, that point may come to appeare in the same place with a point of the further object; and thereby make a middling colour.

So that in this case, the white which is neerer, will mingle his feeble picture with the black that is further off: whereas before the black that was further off, mingled his feeble shadow with the strong picture of the neerer white. Wherefore by our rule we borrowed of the painters, there will now appeare a blew on the further end of the paper, where before appeared a red; and by consequence on the neerer end a red will now appeare, where in the former case a blew appeared. This case we have chosen, as the plainest to shew the nature of such colours: out of which he that is curious, may derive his knowledge to other cases, which wee omit; because our intent is onely to give a generall doctrine, and not the particulars of the Science: and rather to take away admiration, then to instruct the Reader in this matter.

6. The reason of the various colours in generall by pure light passing through a prisme.

As for the various colours, which are made by strayning light through a glasse, or through some other Diaphanous body; to discover the causes and variety of them, we must examine what things they are that do concurre to the making of them: and what accidents may arrive unto those things, to vary their product. It is cleare, that nothing interveneth or concurreth to the producing of any of these colours, besides the light it selfe which is dyed into colour, and the glasse or Diaphanous body through which it passeth. In them therefore, and in nothing else, we are to make our enquiry.

To

To begin then, wee may obſerve, that light paſſing through a priſme, and being caſt upon a reflecting object, is not alwayes colour; but in ſome circumſtances it ſtill continueth light, and in others it becommeth colour. Withall wee may obſerve that thoſe beames which continue light, and endure very little mutation by their paſſage, making as many refractions, do make much greater deflexions from the ſtraight lines by which they came into the glaſſe, then thoſe rayes doe which turne to colour; as you may experience, if you oppoſe one ſurface of the glaſſe perpendicularly to a Candle, and ſet a paper (not irradiated by the candle) oppoſite to one of the other ſides of the glaſſe: for upon the paper, you ſhall ſee faire light ſhine without any colour: and you may perceive, that the line by which the light commeth to the paper, is almoſt perpendicular to that line by which the light commeth to the Priſme. But when light becommeth colour, it ſtriketh very obliquely upon one ſide of the glaſſe; and commeth likewiſe, very obliquely out of the other, that ſendeth it in colour upon a reflectent body; ſo that in concluſion, there is nothing left us whereupon to ground the generation of ſuch colours, beſides the littleneſſe of the angle and the ſloapingneſſe of the line, by which the illuminant ſtriketh one ſide of the glaſſe, and commeth out at the other, when colours proceed from ſuch a percuſſion.

To this then we muſt wholly apply our ſelves: and knowing that generally, when light falleth upon a body with ſo great a ſloaping or inclination, ſo much of it as getteth through, muſt needs be weake and much diffuſed; it followeth that the reaſon of ſuch colours, muſt neceſſarily conſiſt in this diffuſion and weakeneſſe of light; which the more it is diffuſed, the weaker it groweth; and the more lines of darkneſſe, are between the lines of light, and do mingle themſelves with them.

To confirme this, you may obſerve, how juſt at the egreſſe from the priſme of that light which going on a little further becommeth colours, no colour at all appeareth upon a paper oppoſed cloſe to the ſide of the glaſſe; untill removing it further off, the colours begin to ſhew themſelves upon the edges: thereby convincing manifeſtly, that it was the exceſſe of light which hindered them from appearing at the firſt. And in like manner, if you put a burning glaſſe betweene the light and the priſme,

so as to multiply the light which goeth through the prisme to the paper, you destroy much of the colour by converting it into light. But on the other side, if you thicken the ayre, and make it dusky with smoake, or with dust; you will plainely see, that where the light commeth through a convexe glasse (perpendicularly opposed to the illuminant) there will appeare colours on the edges of the cones that the light maketh: and peradventure the whole cones would appeare coloured if the darkning were conveniently made: for if an opacous body be set within either of the cones, its sides will appeare coloured, though the ayre be but moderately thickned: which sheweth that the addition of a little darkenesse, would make that which otherwise appeareth pure light, be throughly dyed into colours. And thus you have the true and adequate cause of the appearance of such colours.

7. Upon what side every colour appeareth that is made by pure light passing through a prisme.

Now, to understand what colours, and upon which sides, will appeare: we may consider, that when light passeth through a glasse, or other diaphanous body, so much of it as shineth in the ayre, or upon some reflecting body bigger then it selfe, after its passage through the glasse, must of necessity have darkenesse on both sides of it; and so be comprised and limited by two darknesses: but if some opacous body, that is lesse then the light, be put in the way of the light, then it may happen contrariwise, that there be darkenesse (or the shadow of that opacous body) between two lights.

Againe, we must consider, that when light falleth so upon a prisme as to make colours, the two outward rayes which proceed from the light to the two sides of the superficies at which the light entereth, are so refracted that at their comming out againe through the other superficies, that ray which made the lesse angle with the outward superficies of the glasse, going in, maketh the greater angle with the outside of the other superficies, comming out: and contrariwise, that ray which made the greater angle, going in, maketh the lesser, at its comming out: and the two internall angles, made by those two rayes, and the outside of the superficies they issue at, are greater then two right angles: and so we see that the light dilateth it selfe at its comming out.

Now, because rayes that issue through a superficies, the neerer they

they are to be perpendiculars unto that ſuperficies, ſo much the thicker they are: it followeth, that this dilatation of light at its comming out of the glaſſe, muſt be made and muſt encreaſe from that ſide where the angle was leaſt at the going in, and greateſt at the comming out: ſo that, the neerer to the contrary ſide you take a part of light, the thinner the light muſt be there: and contrariwiſe, the thicker it muſt be, the neerer it is unto the ſide where the angle at the rayes comming out is the greater. Wherefore, the ſtrongeſt light, (that is, the place where the light is leaſt mixed with darkneſſe) muſt be neerer that ſide then the other. Conſequently hereunto, if by an opacous body you make a ſhadow comprehended within this light, that ſhadow muſt alſo have its ſtrongeſt part, neerer unto one of the lights betwixt which it is compriſed, then unto the other: for, ſhadow being nothing elſe, but the want of light, hindred by ſome opacous body; it muſt of neceſſity lie averſed from the illuminant, juſt as the light would have laine if it had not been hindred. Wherefore, ſeeing that the ſtronger ſide of light, doth more impeach the darkneſſe, then the feebler ſide doth; the deepeſt darke muſt incline to that ſide, where the light is weakeſt; that is, towards that ſide on which the ſhadow appeareth, in reſpect of the opacous body or of the illuminant, and ſo be a cauſe of deepneſſe of colour on that ſide, if it happen to be fringed with colour.

## THE ONE AND THIRTIETH CHAPTER.

### *The cauſes of certaine appearances in luminous colours; with a concluſion of the diſcourſe touching the ſenſes and the ſenſible qualities.*

The reaſon of each ſeverall colour in particular cauſed by light paſſing through a priſme.

OUt of theſe grounds we are to ſeeke the reſolution of all ſuch ſymptoms as appear unto us in this kind of colours. Firſt therefore calling to mind, how we have already declared, that the red colour is made by a greater proportion of light mingled with darkneſſe, and the blew with a leſſe proportion: it muſt follow, that when light paſſeth through a glaſſe in ſuch ſort as to make colours; the mixture of the light and darkneſſe on that ſide where the light is ſtrongeſt will encline to a red:

red: and their mixture on the other ſide, where the light is weakeſt, will make a violet or blew: and this we ſee to fall out accordingly, in the light which is tincted by going through a priſme; for a red colour appeareth on that ſide from which the light doth dilate or encreaſe, and a blew is on that ſide towards which it decreaſeth.

Now if a darke body be placed within this light, ſo as to have the light come on both ſides of it: we ſhall ſee the contrary happen about the borders of the picture or ſhadow of the darke body: that is to ſay, the red colour will be on that ſide of the picture which is towards or over againſt the blew colour that is made by the glaſſe: and the blew of the picture will be on that ſide which is towards the red that is made by the glaſſe, as you may experience if you place a ſlender opacous body along the priſme in the way of the light, either before or behind the priſme. The reaſon whereof is, that the opacous body ſtanding in the middle, environed by light, divideth the light, and maketh two lights of that which was but one; each of which lights, is compriſed between two darkneſſes, to wit, between each border of ſhadow that joyneth to each extream of the light that cometh from the glaſſe, and each ſide of the opacous bodies ſhadow. Wherefore, in each of theſe lights; or rather in each of their commixtions with darkneſſe, there muſt be red on the one ſide, and blew on the other; according to the courſe of light which we have explicated.

And thus it falleth out, agreeable to the rule we have given, that blew commeth to be on that ſide of the opacous bodies ſhadow on which the glaſſe caſteth red, and red on that ſide of it on which the glaſſe caſteth blew: likewiſe when light going through a convexe glaſſe maketh two cones, the edges of the cone betwixt the glaſſe and the point of concurſe will appeare red, if the roome be darke enough: and the edges of the further cone, will appeare blew, both for the reaſon given: for in this caſe the point of concourſe is the ſtrong light betwixt the two cones: of which, that betwixt the glaſſe and the point, is the ſtronger, that beyond the point the weaker: and for this very reaſon, if an opacous body be put in the axis of theſe two cones, both the ſides of its picture will be red, if it be held in the firſt cone which is next to the glaſſe; and both will be blew if the body be ſituated

in the further cone; for both sides being equally situated to the course of the light, within its owne cone, there is nothing to vary the colours, but onely the strength and the weakneſse of the two lights of the cones, on this side, and on that side the point of concurſe: which point, being in this case the strong and cleare light whereof we made generall mention in our precedent note, the cone towards the glasse and the illuminant, is the stronger side, and the cone from the glasse, is the weaker.

In those cases, where this reason is not concerned, we shall see the victory carried in the question of colours, by the shady side of the opacous body: that is, the blew colour will still appeare on that side of the opacous bodies shadow that is furthest from the illuminant. But where both causes doe concurre and contrast for precedence, there the course of the light carrieth it: that is to say, the red will be on that side of the opacous bodies shadow where it is thicker and darker, and blew on the other side where the shadow is not so strong; although the shadow be cast that way that the red appeareth: as is to be seen, when a slender body is placed betwixt the prisme and the reflectent body, upon which the light and colours are cast through the prisme: and it is evident, that this cause of the course of the shadow, is in it self a weaker cause, then the other of the course of light, and must give way unto it whensoever they encounter (as it can not be expected, but that in all circumstances, shadows should be light) because the colours which the glasse casteth in this case, are much more faint and dusky then in the other.

For effects of this latter cause, we see that when an opacous body lyeth crosse the prisme, whiles it standeth end-waies, the red or blew colour will appeare on the upper or lower side of its picture, according as the illuminant is higher or lower then the transverse opacous body: the blew ever keeping to that side of the picture, that is furthest from the body, and the illuminant that make it: and the red the contrary; likewise if an opacous body be placed out of the axis, in either of the cones we have explicated before, the blew will appeare on that side of the picture which is furthest advanced in the way that the shadow is cast: and the red, on the contrary: and so, if the opacous body be placed in the first cone (beside the axis) the red will appeare on that side of the picture in the basis of the second cone, which

is next to the circumference; and the blew, on that side, which is next the axis: but if it be placed on one side of the axis in the second cone, then the blew will appeare on that side the picture which is next the circumference; and the red, on that side, which is next the center of the basis of the cone.

2. A difficult probleme resolved touching the prisme.

There remaineth yet one difficulty of moment to be determined: which is why, when through a glasse, two colours (namely, blew and red) are cast from a candle upon a paper or wall, if you put your eye in the place of one of the colours that shineth upon the wall, and so that colour commeth to shine upon your eye, in such sort that another man who looketh upon it, will see that colour plainly upon your eye, nevertheless, you shall see the other colour in the glasse? As for example, if on your eye there shineth a red, you shall see a blew in the glasse, and if a blew shineth upon your eye, you shall see a red.

The reason hereof is, that the colours which appeare in the glasse, are of the nature of those luminous colours which we first explicated, that arise from looking upon white and blacke bordering together: for a candle standing in the ayre, is as it were a white situated betweene two blackes: the circumstant dusky ayre, having the nature of a blacke: so then, that side of the candle which is seen through the thicker part of the glasse, appeareth red; and that which is seen through the thinner, appeareth blew: in the same manner as when we looke through the glasse; whereas, the colours shine contrarywise upon a paper or reflecting object, as we have already declared, together with the reasons of both these appearances; each fitted to its proper case, of looking through the glasse upon the luminous object surrounded with darkenesse, in the one; and of observing the effect wrought by the same luminous object in some medium or upon some reflectent superficies, in the other.

And to confirme this, if a white paper be set standing hollow before the glasse (like halfe a hollow pillar, whose flat standeth edgewaies towards the glasse, so as both the edges may be seen through it) the further edge will seem blew, and the neerer will be red; and the like will happen, if the paper be held in the free ayre parallell to the lower superficies of the glasse, without any blacke carpet to limit both ends of it (which serveth to make the colours the smarter) so that in both cases, the ayre serveth manifestly

festly for a blacke; in the first, betweene the two white edges; and in the second, limiting the two white ends: and by consequence, the ayre about the candle must likewise serve for two blackes, including the light candle berweene them.

Severall other delightfull experiments of luminous colours I might produce, to confirme the grounds I have layd, for the nature and making of them. But I conceived that these I have mentioned, are abundantly enough for the end I propose unto my selfe: therefore I will take my leave of this supple and nice subject; referring my Reader (if he be curious to entertaine himselfe with a full variety of such shining wonders) to our ingenious Countreyman, and my worthy friend, Mr. Hall: who at my last being at Liege, shewed me there most of the experiences I have mentioned; together with severall other very fine and remarkable curiosities concerning light; which he promised me he would shortly publish in a worke, that he had already cast and almost finished upon that subject: and in it, I doubt not but he will give entire satisfaction to all the doubts and Problems that may concur in this subject: whereas my little exercise formerly, in making experiments of this kind, and my lesse conveniency of attempting any now, maketh me content my selfe with thus spinning ot a course thred from wooll carded me by others, that may runne through the whole doctrine of colours, whose causes have hitherto been so much admired: and that it will do so, I am strongly perswaded both because if I look upon the causes which I have assigned *a priori*, me thinkes they appeare very agreeable to nature and to reason; and if I apply them to the severall Phænomens which Mr. Hall shewed me, and to as many others, as I have otherwise met with, I finde they agree exactly with them and render a full account of them.

And thus you have the whole nature of luminous colours, resolved into the mixtion of light and darknesse: by the due ordering of which, who have skill therein, may produce any middle colour he pleaseth: as I my selfe have seen the experience of infinite changes in such sort made; so that it seemeth unto me, nothing can be more manifest, then that luminous colours are generated in the way that is here delivered. Of which how that gentle, and obedient Philosophy of *Qualities* (readily obedient to what hard taske soever you affigne it) will render a rationall account;

account; and what discreet vertue, it will give the same things to produce different colours, and to make different appearances, meerely by such nice changes of situation, I do not well understand: but peradventure the Patrones of it, may say that every such circumstance is a *Conditio sine qua non*: and therewith (no doubt) their Auditors will be much the wiser in comprehending the particular nature of light, and of the colours that have their origine from it.

3. Of the rain-bow, and how by the colour of any body we may know the composition of the body it selfe.

The Rainebow, for whose sake most men handle this matter of luminous colours, is generated in the first of the two waies we have delivered for the production of such colours: and hath its origine from refraction, when the eye being at a convenient distance from the refracting body, looketh upon it to discerne what appeareth in it. The speculation of which may be found in that excellent discourse of Mounseur des Cartes, which is the sixt of his Meteors; where he hath with great accurateness delivered a most ingenious doctrine of this mystery: had not his bad chance of missing in a former principle (as I conceive) somewhat obscured it. For he there giveth the cause so neat, and so justly calculated to the appearances, as no man can doubt but that he hath found out the true reason of this wonder of nature, which hath perplexed so many great wits: as may almost be seen with our very eyes; when looking upon the fresh deaw in a Sunshiny morning, we may in due positions perceive the rainbow colours, not three yards distant from us: in which we may distinguish even single drops with their effects. But he having determined the nature of light to consist in motion, and proceeding consequently, he concludeth colours to be but certaine kinds of motion; by which I feare it is impossible that any good account should be given of the experiences we see.

But what we have already said in that point, I conceive is sufficient to give the Reader satisfaction therein: and to secure him, that the generation of the colours in the rain-bow, as well as all other colours, is likewise reduced to the mingling of light and darkness: which is our principall intent to prove: adding thereunto by way of advertisement, for others whose leisure may permit them to make use thereof, that who shall ballance the proportions of luminous colours may peradventure make himselfe a step to judge of the natures of those bodies, which really

really and constantly doe weare like dyes; for, the figures of the least parts of such bodies, joyntly with the connexion or mingling of them with pores, must of necessity be that which maketh them reflect light unto our eyes, in such proportions, as the luminous colours of their tincture and semblance do.

For two things are to be considered in bodies, in order to reflecting of light: either the extancies and cavities of them; or their hardnesse and softnesse. As for the first; the proportions of light mingled with darknesse will be varied, according as the extancies or the cavities do exceed, and as each of them is great or small: since cavities have the nature of darknesse, in respect of extancies, as our moderne Astronomers do shew, when they give account of the face (as some call it) in the orbe of the Moone. Likewise in regard of soft or of resistent parts, light will be reflected by them, more or lesse strongly, that is, more or lesse mingled with darknesse; for whereas it reboundeth smartly backe, if it striketh upon a hard and a resistent body, and accordingly will shew it selfe in a bright colour: it must of necessity not reflect at all, or but very feebly, if it penetrateth into a body of much humidity, or if it looseth it selfe in the pores of it; and that little which commeth so weakely from it, must consequently appeare of a dusky die: and these two, being all the causes of the great variety of colours we see in bodies according to the quality of the body, in which the reall colour appeareth, it may easily be determined from which of them it proceedeth: and then by the colour, you may judge of the composition and mixture of the rare and dense parts, which by reflecting light begetteth it.

In fine, out of all we have hitherto said in this Chapter, we may conclude the primary intent of our so long discourse; which is, that as well the senses of living creatures, as the sensible qualities in bodies, are made by the mixtion of rarity and density, as well as the naturall qualities we spoke of in their place: for it cannot be denied but that heate and cold, and the other couples or paires, which beate upon our touch, are the very same as we see in other bodies: the qualities which move our taste and smell, are manifestly a kin and joyned with them: light we have concluded to be fire: and of motion (which affecteth our eare) it is not disputable: so that it is evident, how all sensible qualities,

4. That all the sensible qualities are reall bodies resulting out of several mixtures of rarity and density.

qualities, are as truely bodies, as those other qualities which we call naturall.

To this we may adde, that the properties of these sensible qualities are such as proceed evidently from rarity and density; for (to omit those which our touch taketh notice of, as too plain to be questioned) Physitians judge and determine the naturall qualities of meats, and of medicines, and of simples by their tastes and smels: by those qualities they finde out powers in them to do materiall operations, and such as our instruments for cutting, filing, brushing, and the like do unto ruder and grosser bodies. All which vertues being in these instruments by the different tempers of rarity and density, is a convincing argument, that it must be the same causes, which must produce effects of the same kind in their smels and tastes: and as for light, it is known how corporeally it worketh upon our eyes.

Againe, if we look particularly into the composition of the organes of our senses, we shal meet with nothing but such qualities as we finde in the composition of all other naturall bodies. If we search into our eye, we shall discover in it nothing but diaphaneity, softnesse, divers colours, and consistencies; which all Anatomists, to explicate, do parallell in other bodies: the like is of our tongue, our nosethrils and our eares. As for our touch; that is so materall a sense, and so diffused over the whole body, we can have no difficulty about it. Seeing then that all the qualities we can discover in the organes of our senses, are made by the various minglings of rarity with density, how can we doubt, but that the active powers over these patients, must be of the same nature and kind?

Againe, seeing that examples above brought, doe convince, that the objects of one sense, may be known by another; who can doubt of a community among them, if not of degree at the least of the whole kind? As we see that the touch is the groundworke of all the rest; and consequently, that being evidently corporeall and consisting in a temper of rarity and density, why should we make difficulty in allowing the like of the rest?

Besides, let us compose of rarity and density, such tempers as we finde in our senses; and let us againe compose of rarity and density, such actors as we have determined the qualities, which we call sensible, to be; and will it not manifestly follow, that

these

these two applied to one another, must produce such effects, as we affirme our senses have? that is, to passe the outward objects, by different degrees, unto an inward receiver.

Why the senses are onely five in number: with a conclusion of all the former doctrin concerning them.

Againe, let us cast our eyes upon the naturall resolution of bodies, and how they move us, and we shall thereby discover, both what the senses are, and why they are just so many, and that they cannot be more. For an out ward body may move us, either in its owne bulke or quantity; or as it worketh upon another. The first is done by the touch, the second by the eare, when a body moving the ayre, maketh us take notice of his motion. Now in resolution there are three active parts proceeding from a body which have power to move us. The fiery part, which you see worketh upon our eyes, by the vertue of light. The ayrie part, which we know moveth our nosethrils, by being sucked in with the ayre. And lastly the salt, which dissolveth in water, and so moveth our watry sense; which is our taste.

And these being all the active parts, that shew themselves in the resolution of a body; how can we imagine there should be any more senses to be wrought upon? for what the stable body sheweth of it selfe, will be reduced to the touch: what as it moveth, to hearing: what the resolutions of it according to the natures of the resolved atomes that fly abroad; will concerne the other three senses, as we have declared. And more waies of working, or of active parts, we cannot conceive to spring out of the nature of a body.

Finally, if we cast our eyes upon the intention of nature: to what purpose are our senses, but to bring us into knowledge of the natures of the substances we converse withall? surely, to effect this, there cannot be invented a better, or more reasonable expedient, then to bring unto our judgement seate the likenesses or extracts of those substances, in so delicate a modell, that they may not be offensive or cumbersome; like so many patternes presented unto us, to know by them, what the whole piece is: for all similitude is a communication betweene two things in that quality, wherein their likenesse consisteth: and therefore we cannot doubt, but that nature hath given us by the meanes we have explicated, an essay to all the things in the world, that fall under our commerce, whereby of judge whether they be profitable or nocive unto us; and yet in so delicate and

subtile a quantity, as may in no waies be offensive to us, whiles we take our measures to attract what is good, and avoyd what is noxious.

## THE TWO AND THIRTIETH CHAPTER.

### *Of sensation, or the motion whereby sense is properly exercised.*

1. Mounsieur des Cartss his opinion touching sensation.

OUt of the considerations which we have delivered in these last Chapters, the Reader may gather the unreasonableneſse of vulgar Philosophers, who to explicate life and sense, are not content to give us termes without explicating them; but will force us to believe contradictions: telling us, that life consisted in this, that the same thing hath a power to worke upon it selfe: and that sensation, is a working of the active part of the same sense, upon its passive part; and yet will admit no parts in it: but will have the same indivisible power worke upon it selfe. And this, with such violence and downebearing of all opposition, that they deeme him not considerable in the schooles, who shall offer only to doubt of what they teach him hereabout; but brand him with the censure of one who knoweth not, and contradicteth the very first principles of Philosophy. And therefore, it is requisite we should looke somewhat more particularly into the manner how sensation is made.

Mounsieur des Cartes (who by his great and heroike attempts, and by shewing mankind how to steere and husband their reason to best advantage, hath left us no excuse for being ignorant of any thing worth the knowing) explicating the nature of sense, is of opinion, that the bodies without us, in certaine circumstances, doe give a blow upon our exterior organes: from whence, by the continuity of the parts, that blow or motion is continued, till it come to our braine and seate of knowledge; upon which it giveth a stroke answerable to that, which the outward sense first received: and there this knocke causing a particular effect, according to the particular nature of the motion (which dependeth of the nature of the object that produceth it) our soule and mind hath notice by this meanes, of every thing

thing that knocketh at our gates: and by the great variety of knocks or motions that our braine feeleth (which riſeth from as great a variety of natures in the objects that cauſe them) we are enabled to judge of the nature and conditions of every thing we converſe withall.

As for example: he conceiveth light to be nothing elſe but a percuſſion made by the illuminant upon the ayre, or upon the ethereall ſubſtance, which he putteth to be mixed with, and to runne through all bodies: which being a continuate medium between the illuminant and our ſenſe; the percuſſion upon that, ſtriketh alſo our ſenſe; which he calleth the nerve that reacheth from the place ſtrucken (to wit, from the bottome of our eye) unto the braine. Now, by reaſon of the continuity of this ſtring or nerve, he conceiveth that the blow which is made upon the outward end of it by the ether, is conveyed by the other end of it to the braine; that end, ſtriking the braine in the ſame meaſure as the ether ſtrucke the other end of it: like the jacke of a Virginall, which ſtriketh the ſounding cord, according as the Muſitians hand preſſeth upon the ſtop. The part of the braine which is thus ſtrucken, he ſuppoſeth to be the fantaſie, where he deemeth the ſoule doth reſide; and thereby taketh notice of the motion and object that are without. And what is ſaid thus of ſight, is to be applied proportionably to the reſt of the ſenſes.

This then is the ſumme of Monſieur des Cartes his opinion, which he hath very finely expreſſed, with all the advantages that oppoſite examples, ſignificant words, and cleare method can give unto a witty diſcourſe. Which yet is but a part of the commendations he deſerveth, for what he hath done on this particular. He is over and above all this, the firſt that I have ever met with, who hath publiſhed any conceptions of this nature, whereby to make the operations of ſenſe intelligible. Certainely, this praiſe will ever belong unto him, that he hath given the firſt hint of ſpeaking groundedly, and to the purpoſe upon this ſubject, and whoſoever ſhall carry it any further (as what important myſtery was ever borne and perfected at once?) muſt acknowledge to have derived his light from him.

For my part, I ſhall ſo farre agree with him as to allow mo-

The Authors opinion touching ſenſation.

tion alone to be ſufficient to worke ſenſation in us: and not onely to allow it ſufficient, but alſo to profeſſe, that not onely this, but that no other effect whatſoever can be wrought in us, but motion, and by meanes of motion. Which is evident out of what we have already delivered, ſpeaking of bodies in generall; that all action among them, either is locall motion, or elſe followeth it: and no leſſe evident, out of what we have declared in particular, concerning the operations of the outward ſenſes, and the objects that worke upon them: and therefore, whoſoever ſhall in this matter, require any thing further then a difference of motion, he muſt firſt ſeeke other inſtruments in objects to cauſe it. For, examining from their very origine, the natures of all the bodies we converſe withall; we cannot finde any ground to believe they have power or meanes to worke any thing beyond motion.

But I ſhall crave leave to differ from him, in determining what is the ſubject of this motion, whereby the braine judgeth of the nature of the thing that cauſeth it. He will allow no locall change of any thing in a man, further then certaine vibrations of ſtrings, which he giveth the objects to play upon from the very ſenſe up to the braine: and by their different manners of ſhaking the braine, he will have it know, what kind of thing it is that ſtriketh the outward ſenſe, without removing any thing within our body from one place to another. But I ſhall goe the more common way; and make the ſpirits to be the porters of all newes to the braine: onely adding thereunto that theſe newes which they carry thither, are materiall participations of the bodies, that worke upon the outward organes of the ſenſes; and paſſing through them, do mingle themſelves with the ſpirits, and ſo doe goe whither they carry them, that is, to the braine: unto which, from all parts of the body, they have immediate reſort, and a perpetuall communcation with it.

So that, to exerciſe ſenſe (which the Latines doe call *ſentire*, but in Engliſh we have no one word common to our ſeverall particular notions of divers perceptions by ſenſe) is, *Our braine to receive an impreſſion from the externe object by the operation or mediation of an organicall part made for that purpoſe, and ſome one of thoſe which we terme an externe ſenſe; from which impreſſion, uſually floweth ſome motion proper to the living creature.*

*tare.* And thus you see that the outward senses, are not truly senses as if the power of sensation were in them: but in another meaning, to wit, so farre as they are instruments of qualifying or conveying the object to the braine.

Now, that the spirits are the instruments of this conveyance, is evident, by what we daily see, that if a man be very attentive to some one externe object (as to the hearing or seeing of something that much delighteth or displeaseth him) he neither heareth or seeth any thing but what his mind is bent upon; though all that while, his eyes and eares be open, and severall of their objects be present, which at other times would affect him. For what can be the reason of this, but that the braine employing the greatest part of his store of spirits about that one object, which so powerfully entertaineth him, the others find very few free for them to imbue with their tincture? And therefore, they have not strength enough to give the braine a sufficient taste of themselves, to make it be observed; nor to bring themselves into a place where they may be distinctly discerned: but striving to get unto it, they lose themselves in the throng of the others, who for that time doe besiege the braine closely. Whereas, in Monsieur des Cartes his way (in which no spirits are required) the apprehension must of necessity be carried precisely according to the force of the motion of the externe object.

3. Reasons to perswade the authors opinion.

This argument I confesse, is not so convincing a one against his opinion, but that the necessity of the consequence may be avoided; and another reason be given for this effect, in Mounsieur des Cartes his doctrine: for he may say, that the affection being vehemently bent upon some one object, may cause the motion to be so violent by the addition of inward percussions, that the other comming from the outward sense, being weaker, may be drowned by it; as lesser sounds are by greater, which doe forcibly carry our eares their way, and doe fill them so entirely, that the others cannot get in to be heard: or as the drawing of one man that pulleth backewards, is not felt when a hundred draw forwards. Yet this is hard to conceive, considering the great eminency which the present object hath over an absent one, to make it self be felt: whence it followeth, that the multiplication of motion must be extremely encreased within, to overtop

and beare downe the motion, causèd by a presènt object actually working without.

But that which indeed convinceth me to beleeve I goe not wrong in this course, which I have set downe for externe bodies working upon our sense and knowledge: is first, the convenience, and agreeablenesse to nature, both in the objects and in us, that it should be done in that manner: and next, a difficulty in Mounsieur des Cartes his way, which me thinketh, maketh it impossible that his should be true. And then, his being absolutely the best of any I have hitherto met withall, and mine supplying what his falleth short in, and being sufficient to perform the effects we see: I shall not thinke I doe amisse in beleeving my owne to be true, till some body else shew a better.

4 That vitall spirits are the immediate instruments of sensation by conveying sensible qualities to the braine.

Let us examine these considerations one after another. It is manifest by what we have already established, that there is a perpetuall fluxe of little parts or atomes out of all sensible bodies, that are composed of the foure Elements, and are here in the sphere of continuall motion by action and passion: and such it is, that in all probability these little parts cannot chuse but get in at the doores of our bodies, and mingle themselves with the spirits that are in our nerves. Which if they doe, it is unavoydable, but that of necessity they must make some motion in the braine; as by the explication we have made of our outward senses, is manifest: and the braine being the source and origine of all such motion in the animal, as is termed voluntary; this stroke of the object, will have the power to cause some variation in its motions that are of that nature: and by consequence, must be a sensation, for, that change which being made in the braine by the object, is cause of voluntary motion in the animall, is that, which we call sensation.

But we shall have best satisfaction, by considering how it fareth with every sense in particular. It is plain, that our touch or feeling is affected by the little bodies of heate, or cold, or the like, which are squeesed or evaporated from the object; and doe get into our flesh, and consequently, doe mingle themselves with our spirits: and accordingly, our hand is heated with the flood of subtile fire, which from a great one without, streameth into it: and is benummed with multitudes of little bodies of cold, that settle in it. All which little bodies, of heate, or of

cold

cold, or of what kind ſoever they be, when they are once got in, muſt needs mingle themſelves with the ſpirits they meet with in the nerve: and conſequently, muſt go along with them up to the braine: for the channell of the nerve being ſo little, that the moſt accurate inſpectours of nature cannot diſtinguiſh any litle cavity or hole running along the ſubſtance of it: and the ſpirits which ebbe and flow in thoſe channells, being ſo infinitely ſubtill, and in ſo ſmall a quantity, as ſuch channells can containe: it is evident, that an atome of inſenſible bigneſſe, is ſufficient to imbue the whole length and quantity of ſpirit that is in one nerve: and that atome, by reaſon of the ſubtilty of the liquor it is immerſed in, is preſently and as it were inſtantly, diffuſed through the whole ſubſtance of it: the ſource therefore of that liquor being in the braine, it cannot be doubted, but that the force of the externe object muſt needes affect the braine according to the quality of the ſaid atome: that is, give a motion, or knock, conformable to its owne nature.

As for our taſte, it is as plaine, that the little parts expreſſed out of the body which affecteth it, doe mingle themſelves with the liquor, that being in the tongue, is continuate to the ſpirits: and then, by our former argument it is evident, they muſt reach unto the braine. And for our ſmelling, there is nothing can hinder odours from having immediate paſſage up to our brain, when by our noſe, they are once gotten into our head.

5. How ſound is conveyed to the braine by vitall ſpirits.

In our hearing, there is a little more difficulty: for ſound being nothing but a motion of the Ayre, which ſtriketh our eare; it may ſeem more then needeth, to ſend any corporeall ſubſtance into the braine: and that it is ſufficient, that the vibrations of the outward aire, ſhaking the drumme of the eare, doe give a like motion to the ayre within the eare, that on the inſide toucheth the tympane: and ſo this ayre thus moved, ſhaketh and beateth upon the braine. But this, I conceive, will not ſerve the turne; for if there were no more, but an actual motion, in the making of hearing; I doe not ſee, how ſounds could be conſerved in the memory: ſince of neceſſity, motion muſt alwayes reſide in ſome body; which argument, wee ſhall preſſe anone, againſt Mounſieur des Cartes his opinion for the reſt of the ſenſes.

Out of this difficulty, the very inſpection of the parts within

the eare, ſeemeth to lead us: for had there been nothing neceſſary beſides motion, the very ſtriking of the outward ayre againſt the tympanum, would have been ſufficient without any other particular and extraordinary organization, to have produced ſoundes, and to have carried their motions up to the braine: as wee ſee the head of a drumme bringeth the motions of the earth unto our eare, when we lay it thereunto, as we have formerly delivered. But Anatomiſts find other tooles and inſtruments, that ſeem fit to worke and forge bodies withall; which we cannot imagine nature made in vaine. There is a hammer and an anvile: whereof the hammer, ſtriking upon the anvile, muſt of neceſſity beate off ſuch little parts of the brainy ſteames, as flying about, doe light and ſtick upon the top of the anvile: theſe by the trembling of the ayre following its courſe, cannot miſſe of being carried up to that part of the braine, whereunto the ayre within the eare is driven by the impulſe of the ſound: and as ſoon as they have given their knocke, they rebound back againe into the cells of the braine, fitted for harbours to ſuch winged meſſengers: where they remaine lodged with quietneſſe, till they be called for againe, to renew the effect which the ſound did make at the firſt: and the various blowes which the hammer ſtriketh, according to the various vibrations of the tympanum (unto which the hammer is faſtened; and therefore is governed by its motions) muſt needs make great difference of bigneſſes, and cauſe great variety of ſmartneſſes of motion, in the little bodies which they forge.

6 How colours are conveyed to the braine by vitall ſpirits.

The laſt ſenſe is of ſeeing; whoſe action wee cannot doubt, is performed by the reflection of light unto our eye, from the bodies which we ſee: and this light commeth impregnated with a tincture drawne from the ſuperficies of the object it is reflected from; that is, it bringeth along with it, ſeverall of the little atomes, which of themſelves doe ſtreame, and it cutteth from the body it ſtruck upon, and reboundeth from; and they, mingling themſelves with the light, doe in company of it get into the eye: whoſe fabrick, is fit to gather and unite thoſe ſpecies, as you may ſee by the anatomy of it: and from the eye, their journey is but a ſhort one to the braine: in which, wee cannot ſuſpect that they ſhould loſe their force; conſidering, how others that come from organes further off, doe conſerve theirs:

and

and likewiſe conſidering the nature of the optick ſpirits, which are conceived to be the moſt refined of al that are in mans body.

Now, that light is mingled with ſuch little atomes iſſuing out of the bodies from which it is reflected; appeareth evidently enough, out of what we have Sayed, of the nature and operations of fire and light: and it ſeemeth to be confirmed, by what I have often obſerved in ſome chambers where people ſeldome come: which having their windows to the ſouth, ſo as the ſunne lyeth upon them a great part of the day in his greateſt ſtrength, and their curtaines being continually drawne over them, the glaſſe becomes dyed very deepe of the ſame colour the curtaine is of: which can proceed from no other cauſe, but that the beams which ſhoot through the glaſſe, being reflected back from the curtaine, doe take ſomething along with them from the ſuperficies of it; which being of a more ſolide corpulence then they, is left behind (as it were in the ſtrainer) when they come to preſſe themſelves through paſſages and pores, too little for it to accompany them in: and ſo thoſe atomes of colour, doe ſticke upon the glaſſe, which they cannot penetrate.

Another confirmation of it is, that in certaine poſitions, the ſunne reflecting from ſtrong colours, will caſt that very colour upon ſome other place; as I have often experienced in lively ſcarlet, and cloth of other ſmart colours: and this, not in that gloating wiſe, as it maketh colours of pure light, but like a true reall dye; and ſo, as the colour will appeare the ſame to a man, whereſoever he ſtandeth.

Having thus ſhewed in all our ſenſes, the convenience and agreeableneſſe of our opinion with nature; (which hath been deduced, out of the nature of the objects, the nature of our ſpirits, the nature and ſituation of our nerves, and laſtly from the property of our braine:) our next conſideration ſhall be, of the difficulty that occurreth in Mr. des Cartes his opinion. Firſt we know not how to reconcile the repugnancys appearing in his poſition of the motion of the ether; eſpecially in light, for that Ethereal ſubſtance, being extreme rare, muſt perforce be either extreme liquid, or extreme brittle; if the firſt, it cannot chooſe but bow and be preſſed into foulds; and bodies of unequall motions, ſwimming every where in it, and ſo it is impoſſible that it ſhould bring unto the eye any conſtant apparition of the firſt mover.

7 Reaſons againſt Monſieur des Cartes his opinion.

But

But let us ſuppoſe there were no ſuch generall interruptions, every where encountring, and diſturbing the conveyance of the firſt ſimple motion: yet, how can we conceive that a puſh, given ſo farre off, in ſo liquid an element, can continue its force ſo farre? We ſee that the greateſt thunders and concuſſions, which at any time happen among us, cannot drive and impart their impulſe the ten thouſandth part of the vaſt diſtance, which the Sunne is removed from our eye; and can we imagine, that a little touch of that luminous body, ſhould make an impreſſion upon us, by moving another ſo extremely liquid and ſubtile, as the Ether is ſuppoſed; which like an immenſe Ocean, toſſed with all varieties of motion, lyeth between it and us?

But admit there were no difficulty nor repugnance in the medium, to convey unto us a ſtroke, made upon it by the ſunnes motion: let us at the leaſt examine, what kinde of motions wee muſt allow in the ſunne, to cauſe this effect. Certainely, it muſt needs be a motion towards us, or elſe it cannot ſtrike and drive the medium forward, to make it ſtrike upon us. And if it be ſo, either the ſunne muſt perpetually be comming neerer and neerer to us; or elſe it muſt ever and anone be receding backwards, as well as moving forwards. Both which, are too chymericall for ſo great a wit to conceit.

Now, if the Ether be brittle, it muſt needs reflect upon every rubbe it meeteth with in its way, and muſt be broken and ſhivered by every body that moveth acroſſe it: and therefore, muſt alwayes make an uncertaine and moſt diſorderly percuſſion upon the eye.

Then againe; after it is arrived to the ſenſe, it is no wayes likely it ſhould be conveyed from thence to the braine, or that nature intended ſuch a kind of inſtrument as a nerve, to continue a preciſe determinate motion: for if you conſider how a lute ſtring, or any other ſuch medium conveyeth a motion made in it; you will finde, that to doe it well and clearly, it muſt be ſtretched throughout to its full extent, with a kinde of ſtiffneſſe: whereas our nerves are not ſtraight, but lie crooked in our body; and are very lither, till upon occaſion ſpirits comming into them, doe ſwell them out. Beſides, they are bound to fleſh, and to other parts of the body; which being ceſſible, muſt needs dull the ſtroake, and not permit it to be carried farre. And

laſtly,

lastly, the nerves are subject to be at every turne contracted and dilated, upon their owne account, without any relation to the stroakes beating upon them from an externe agent: which is by no meanes, a convenient disposition for a body, that is to be the porter of any simple motion; which should alwayes lie watching in great quietnesse, to observe scrupulously, and exactly the errand hee is to carry: so that for my part, I cannot conceive, nature intended any such effect, by mediation of the sinews.

8. That the symptomes of the palsie doe no way confirme Mounsieur des Cartes his opinion.

But Mounsieur des Cartes endeavoureth to confirme his opinion, by what useth to fall out in palsies, when a man loseth the strength of moving his hands, or other members, and nevertheless retaineth his feeling: which he imputeth to the remaining intire of the strings of the nerves, whiles the spirits are some way defective. To this we may answer, by producing examples of the contrary in some men, who have had the motion of their limbes intire and no wayes prejudiced, but have had no feeling at all, quite over their whole case of skinne and flesh: as particularly a servant in the Colledge of Physitians in London, whom the learned Harvey (one of his Masters) hath told me, was exceeding strong to labour, and very able to carry any necessary burthen, and to remove things dexterously, according to the occasion: and yet he was so voyde of feeling, that he used to grind his hands against the walls, and against course lumber, when he was employed to rummage any; in so much, that they would runne with blood, through grating of the skinne, without his feeling of what occasioned it.

In our way, the reason of both these conditions of people, (the paralytike, and the insensible) is easy to be rendred: for they proceed out of the divers disposition of the animal spirits in these parts: which if they thicken too much, and become very grosse, they are not capable of transmitting the subtile messengers of the outward world, unto the tribunall of the braine, to judge of them. On the other side, if they be too subtile, they neither have, nor give power to swell the skin, and so to draw the muskles to their heads. And surely Mounsieur des Chartes taketh the wrong way, in the reason he giveth of the Palsie: for it proceedeth out of abundance of humours; which clogging the nerves, rendreth them washy, and maketh them lose their drynesse, and become lither, and consequently, unfit and unable, in his

his opinion, for ſenſation (which requireth ſtiffeneſſe) as well as for motion.

9. That Mounſieur des Cartes his opinion, cannot give a good account, how things are conſerved in the memory.

Yet beſides all theſe, one difficulty more remaineth againſt this doctrine, more inſuperable (if I miſtake not) then any thing, or all together wee have yet ſaid: which is, how the memory ſhould conſerve any thing in it, and repreſent bodies to us, when our fanſie calleth for them, if nothing but motions do come into the braine. For it is impoſſible, that in ſo diviſible a ſubject as the ſpirits, motion ſhould be conſerved any long time: as we ſee evidently in the ayre; through which move a flaming taper never ſo ſwiftly, and as ſoone as you ſet it down, almoſt in the very inſtant, the flame of it leaveth being driven or ſhaken on one ſide, and goeth quietly and evenly up its ordinary courſe: thereby ſhewing, that the motion of the ayre, which for the time was violent, is all of a ſoddaine quieted and at reſt: for otherwiſe, the flame of the taper would blaze that way the Ayre were moved. Aſſuredly, the bodies that have power to conſerve motion long, muſt be dry and hard ones. Nor yet can ſuch conſerve it very long, after the cauſe which made it, ceaſeth from its operation. How then can we imagine, that ſuch a multitude of pure motions, as the memory muſt be ſtored withall for the uſe and ſervice of a man, can be kept on foote in his braine, without confuſion; and for ſo long a time as his memory is able to extend unto? Conſider a leſſon plaid upon the Lute or Virginalls; and think with your ſelfe, what power there is, or can be in nature, to conſerve this leſſon ever continually playing: and reflect, that if the impreſſions upon the common ſenſe are nothing elſe but ſuch things, then they muſt be actually conſerved, alwaies actually moving in our head to the end they be immediatly produced, whenſoever it pleaſeth our will to call them.

And if peradventure it ſhould be replyed, that it is not neceſſary the motions themſelves ſhould alwaies be conſerved in actuall being; but that it is ſufficient there be certaine cauſes kept on foot in our heads, which are apt to reduce theſe motions into act, whenſoever there is occaſion of them: all I ſhall ſay hereunto is, that this is meerely a voluntary poſition, and that there appeareth no ground for theſe motions to make and conſtitute ſuch cauſes; ſince we neither meet with any inſtruments,

ments, nor discover any signes, whereby we may be induced to believe or understand any such operation.

It may be urged, that divers sounds are by diseases oftentimes made in our eares, and appearances of colours in our fantasie. But first, these colours and sounds, are not artificiall ones, and disposed and ordered by choice and judgement; for no story hath mentioned, that by a disease any man ever heard twenty verses of Virgill, or an ode of Horace in his eares: or that ever any man saw faire pictures in his fansy, by meanes of a blow given him upon his eye. And secondly, such colours and sounds as are objected, are nothing else, but (in the first case) the motion of humours in a mans eye by a blow upon it; which humours have the vertue of making light, in such sort as we see Sea-water hath, when it is clashed together: and (in the second case) a cold vapour in certaine parts of the braine, which causeth beatings or motion there; whence proceedeth the imitation of sounds: so that these examples do nothing advantage that party thence to infer that the similitudes of objects may be made in the common sense, without any reall bodies reserved for that end.

Yet I intend not to exclude motion from any commerce with the memory no more then I have done from sensation. For I will not only grant, that all our remembring is performed by the meanes of motion; but I will also acknowledge, that (in men) it is, for the most part, of nothing else but of motion. For what are words, but motion? And words are the chiefest objects of our remembrance. It is true, we can, if we will, remember things in their owne shapes, as well as by the words that expresse them; but experience telleth us, that in our familiar conversation, and in the ordinary exercise of our memory, we remember and make use of the words, rather then of the things themselves.

Besides, the impressions which are made upon all our other senses, as well as upon our hearing, are likewise for the most part of things in motion: as if we have occasion to make a conception of a man, or of a horse, we ordinarily conceive him Walking, or Speaking, or Eating, or using some motion in time: and as these impressions are successively made upon the outward Organes; so are they successively carried into the fantasie, and by

by like ſucceſſion, are delivered over into the memory: from whence, when they are called back againe into the fantaſie, they move likewiſe ſucceſſively; ſo that in truth, all our memory will be of motion; or at the leaſt, of bodies in motion: yet it is not chiefly of motion, but of the things that are moved; unleſſe it be, when we remember words: and how thoſe motions, do frame bodies which move in the braine, we have already touched.

## THE THREE AND THIRTIETH CHAP.

### *Of Memory.*

1. How things are conſerved in the memory

But how are theſe things conſerved in the braine? And how do they revive in the fantaſie, the ſame motions by which they came in thither at the firſt? Monſieur des Cartes hath put us in hope of an explication: and were I ſo happy, as to have ſeen that worke of his, which the World of learned men ſo much longeth for; I aſſure my ſelfe, I ſhould herein receive great helpe and furtherance by it. Although withall, I muſt profeſſe, I cannot underſtand how it is poſſible, that any determinate motion ſhould long be preſerved untainted in the braine; where there muſt be ſuch a multitude of other motions in the way, to mingle with it, and bring all into confuſion. One day I hope this jewell will be expoſed to publik view, both to do the Author right, and to inſtruct the World.

In the meane time, let us ſee what our own principles afford us. We have reſolved, that ſenſation is not a pure driving of the animall ſpirits, or of ſome penertrable body in which they ſwim, againſt that part of the braine, where knowledge reſideth: but that it is indeed the driving thither of ſolid materiall bodies (exceeding little ones) that come from the objects themſelves. Which poſition, if it be true, it followeth that theſe bodies muſt rebound from thence upon other parts of the braine; whereat the length they find ſome vacant cell, in which they keepe their ranks and files, in great quiet and order; all ſuch ſticking together, and keeping company with one an other, that entered in together; and there they lye ſtill

and

and are at reſt, untill they be ſtirred up, either by the naturall appetite, (which is the ordinary courſe of beaſtes) or by chance, or by the will of the man in whom they are, upon the occaſions he meeteth with of ſearching into them. Any of theſe three cauſes rayſeth them up, and giveth them the motion that is proper to them; which is the ſame with that, whereby they came in at the firſt: for (as Galilæus teacheth us) every body hath a particular motion peculiarly proper to it, when nothing diverteth it: and then they ſlide ſucceſſively, through the fantaſie in the ſame manner, as when they preſented themſelves to it the firſt time. After which, if it require them no more; they returne gently to their quiet habitation in ſome other part of the braine, from whence they were called and ſummoned by the fantaſies meſſengers, the ſpirits: but if it have longer uſe of them, and would view them better then once paſſing through permitteth; then they are turned back againe, and lead anew over their courſe, as often as is requiſite: like a Horſe, that a Rider paceth ſundry times along by him that hee ſheweth him to; whiles he is attentive to marke every part and motion in him.

2. How things conſerved in the memory are brought backe into the fantaſie.

But let us examine a little more particularly, how the cauſes we have aſſigned, do raiſe theſe bodies that reſt in the memory, and do bring them to the fantaſie. The middlemoſt of them (namely chance) needeth no looking into, becauſe the principles that governe it, are uncertaine ones. But the firſt, and the laſt, (which are, the appetite, and the will) have a power (which we will explicate hereafter) of moving the braine and the nerves depending of it, conveniently and agreeably to their diſpoſition. Out of which it followeth, that the little ſimilitudes, which are in the caves of the braine wheeling and ſwimming about (almoſt in ſuch ſort, as you ſee in the waſhing of Currants or of Rice, by the winding about and circular turning of the Cookes hand) divers ſorts of bodies do go their courſes for a pretty while; ſo that the moſt ordinary objects cannot chooſe but preſent themſelves quickly, becauſe there are many of them, and are every where ſcattered about: but others that are fewer, are longer ere they come in view: much like as in a paire of beades, that containing more little ones then great ones, if you plucke to you the ſtring they all hang upon,

upon, you ſhall meete with many more of one ſort, then of the other.

Now, as ſoone as the braine hath lighted on any of thoſe it ſeeketh for, it putteth as it were a ſtop upon the motion of that; or at the leaſt, it moveth it ſo, that it goeth not far away, and is revocable at will: and ſeemeth like a baite to draw into the fantaſie others belonging unto the ſame thing, either through ſimilitude of nature, or by their connexion in the impreſſion: and by this meanes hindereth other objects, not pertinent to the work the fanſie hath in hand, from offering themſelves unſeaſonably in the multitudes that otherwiſe they would do. But if the fanſie ſhould have miſtaken one object for an other, by reaſon of ſome reſemblance they have between themſelves; then it ſhaketh againe the liquid medium they all floate in, and rooſeth every ſpecies lurking in remoteſt corners, and runneth over the whole headroule of them: and continueth this inquiſition and motion, till either it be ſatisfyed with retriving at length what it required, or that it be growne weary with toſſing about the multitude of little inhabitants in its numerous empire, and ſo giveth over the ſearch, unwillingly and diſpleaſedly.

3. A Confirmation of the former doctrine.

Now, that theſe things be as we have declared, will appeare out of the following conſiderations; firſt, we ſee that things of quite different natures, if they come in together, are remembred together: upon which principle the whole art of memory dependeth: ſuch things cannot any way be compriſed under certaine heads, nor be linked together by order and conſequence, or by any reſemblance to one an other: and therefore all their connexion muſt be, that as they came in together into the fantaſie, ſo they remaine together in the ſame place in the memory: and their firſt coupling muſt proceed from the action that bound them together, in driving them in together.

Next, we may obſerve, that when a man ſeeketh and tumbleth in his memory for any thing he would retrive, he hath firſt ſome common and confuſed notion of it: and ſometimes he hath a kind of flasking or fading likeneſſe of it: much what, as when in ſtriving to remember a Name, men uſe to ſay, it is at their tongues end: and this ſheweth, that he attracteth thoſe things he deſireth, and hath uſe of, by the likeneſſe of ſome-

thing

thing belonging to them. In like manner, when hunger maketh one think of meat, or thirſt maketh one dreame of drink, or in other ſuch occaſions, wherein the naturall appetite ſtirreth objects in the memory and bringeth them to the fantaſie; it is manifeſt, that the ſpirits informing the braine of the defect and paine, which ſeverall parts of the body do endure, for want of their due nouriſhment; it giveth a motion to the heart, which ſendeth other ſpirits up to ſupply the braine, for what ſervice it will order them: by which, the braine being fortifyed, it followeth the purſuite of what the living creature is in want of; untill the diſtempered parts be reduced into their due ſtate, by a more ſolid enjoying of it.

4. How things renewed in the fantaſie, returne with the ſame circumſtances that they had at firſt

Now, why objects that are drawn out of the memory, do uſe to appeare in the fantaſie, with all the ſame circumſtances which accompanied them at the time when the ſenſe did ſend them thither, (as when in the remembrance of a friend, we conſider him in ſome place, and at a certaine time, and doing ſome determinate action) the reaſon is, that the ſame body, being in the ſame medium, muſt neceſſarily have the ſame kind of motion; and ſo conſequently, muſt make the ſame impreſſion upon the ſame ſubject. The medium which theſe bodies move in (that is, the memory) is a liquid vaporous ſubſtance, in which they floate and ſwim at liberty.

Now, in ſuch a kind of medium, all the bodies that are of one nature, will eaſily gather together, if nothing diſturbe them: for as when a tuned Lute ſtring is ſtrucken, that ſtring by communicating a determinate ſpecies of vibration to the Ayre round about it, ſhaketh other ſtrings, within the compaſſe of the moved ayre; not all, of what extent ſoever, but onely ſuch, as by their naturall motion, would cauſe like curlings, and fouldes in the Ayre, as the other doth; according to what Galileus hath at large declared: even ſo, when ſome atome in the braine is moved, all the reſt there about, which are apt to be wafted with a like undulation, muſt needs be moved in chiefe: and ſo they moving, whiles the others of different motions, that having nothing to rayſe them, do either ly quiet or move very little in reſpect of the former; it is no wonder if they aſſemble together, and (by the proper courſe of the braine) do meet at the common rendezvous of the fantaſie.

5. How the memory of things past is lost, or confounded: and how it is repaired againe.

And therefore the more impressions, that are made from the same object upon the sense, the more participations of it will be gathered together in the memory: and the stronger impressions, it will upon occasion make in the fantasie: and themselves will be the stronger to resist any cause that shall strive to deface them. For we see that multitude of objects overwhelmeth the memory; and putteth out, or at the least, maketh unprofitable, those that are seldomest thought on. The reason of which is, that they being little in quantity, because there are but few species of them; they can never strike the seate of knowledge, but in company of others; which being more and greater, doe make the impression follow their nature against the lesser: and in tract of time, things seldome thought of, doe grow to have but a maimed and confused shape in the memory; and at length are quite forgotten. Which happeneth, because in the liquid medium, they are apt to moulder away, if they be not often repaired: which mouldring and defacing, is helped on by the shockes they receive from other bodies: like as in a magazin, a thing that were not regarded, but were carelesly tumbled up and downe, to make roome for others, and all things were promiscuously throwne upon it; it would soone be bruised and crushed into a mishapen forme, and in the end be broken all in pieces.

Now, the repairing of any thing in the memory, is done, by receiving new impressions from the object; or in its absence, by thinking strongly of it: which is an assembling, and due peecing together of the severall particles of bodies, appertaining to the same matter. But sometimes it happeneth, that when the right one cannot be found intire, nor all the orderly pieces of it, be retrived with their just correspondence to one another; the fansie maketh up a new one in the place of it: which afterwards, upon presence of the object, appeareth to have beene mistaken: and yet the memory, till then, keepeth quietly and unquestionedly for the true object, what either, the thought, or chance, mingling severall parts, had patched up together.

And from hence, we may discern, how, the loosing or confounding of ones memory, may happen either by sicknesses, that distemper the spirits in the braine, & disorder their motions, or by some

some blowes on the head, whereby a man is astonied, and all things seeme to turne round with him. Of all which effects, the causes are easy to be found in these suppositions wee have layed.

## THE FOURE AND THIRTIETH CHAP.

### *Of voluntary motion, Naturall faculties, and passions.*

1. Of what matter the braine is composed.

HItherto we have laboured to convery the object into the braine: but when it is there, let us see what further effects it causeth: and how that action, which we call *voluntary motion*, doth proceed from the braine. For the discovery whereof, we are to note, that the braine is a substance composed of watry parts mingled with earthy ones: which kind of substances we see are usually full of strings: and so in strong hard beere, and in vinegar, and in other liquors of the like nature, we see (if they be exposed to the Sunne) little long flakes, which make an appearance of Wormes or Maggats floating about. The reason whereof is, that some dry parts of such liquors, are of themselves as it were hairy or sleasy, that is, have little downy parts, such as you see upon the legs of Flies, or upon Caterpillars, or in little locks of wooll; by which they easily catch and stick to the other little parts of the like nature, that come neer unto them: and if the liquor be moved, (as it is in the boyling of beere, or making of vinegar by the heate of the Sun) they become long strings; because the liquor breaketh the ties which are crosse to its motion: but such as lie along the streame, or rather the bubling up, do maintaine themselves in unity, and peradventure grow stronger, by the winding or foulding of the end of one part with an other: and in their tumbling and rouling still in the same course, the downy haires are crushed in, and the body groweth long and round, as happeneth to a lump of dough, or wax, or wooll, rouled a while in one uniform course. And so, comming to our purpose, we see that the braine, and all that is made of it, is stringy; witnesse, the membranes, the flesh, the bones, &c. But of all the rest, those which be called fibers, are most stringy: and the nerves seem to be but an

assembly of them: for although the nerves be but a great multitude of strings lying in a cluster; nevertheless, by the consent of Physitians and Anatomistes, they are held to be of the very substance of the braine, dryed to a firmer consistence then it is in the head.

This heape of strings (as wee may call it) is enclosed in an outside made of membranes; whose frame, wee need not here display: only we may note, that it is very apt and fit to stretch; and after stretching, to returne againe to its owne just length. Next, we are to consider, how the braine is of a nature apt to swell and to sinke againe: even so much, that Fallopius reporteth, it doth swell according to the encrease of the moone: which whether it be true or no; there can be no doubt, but that it being of a substance which is full of skinnes and strings, is capable of being stretched, and of swelling upon light occasions; and of falling or sinking againe upon as light: as being easily penetrable by vapours and by liquors, whose nature it is, to swell and to extend that which they enter into. Out of which it followeth, that it must be the nature of the nerves to doe the like: and indeed, so much the more, by how much more dry they are then the braine: for wee see that (to a certain measure) drier things are more capable of extention by the ingression of wet, then moist things are; because these are not capable of receiving much more wet into them.

2 What is voluntary motion.

These things being premised; let us imagine that the braine being first swelled, it doth afterwards contract it self; and it must of necessity follow, that seeing the nerves are all open towards the braine (though their concavities cannot be discerned) the spirits and moysture which are in the braine, must needs be pressed into the nerves: which being already stored with spirits, sufficiently to the proportion of their hard skinnes; this addition will make them swell and grow hard, as a balloone doth, which being competently full of ayre, hath nevertheless more ayre pressed into it.

Since therefore, the masters of Anatomy doe teach us, that in every muscle there is a nerve, which is spread into a number of little branches along that muscle; it must follow, that if these little branches be swollen, the flesh likewise of that muscle must also needs be swollen. Now the muscle having both its endes fastened,

fastened, the one in a greater bone, the other in a lesser; and there being least resistance on that part, where the bone is lesser, and more moveable; the swelling of the muscle cannot choose, but draw the little bone towards the great one; and by consequence, move that little bone: and this is that, which Philosophers usually call *Voluntary motion*: for since our knowledge remaineth in the braine, whatsoever is done by knowledge, must be done by the braine; and most of what the braine workth for the common service of the living creature, proceedeth also from knowledge; that is, from the motion of the fansy, which we have expressed.

3. What those powers are which are called naturall faculties.

This matter being thus far declared, wee may now enter upon the explication of certaine effects; which peradventure might have challenged roome, in the precedent Chapter; but indeed, could not well be handled without first supposing this last discourse: and it is, what is meaned by those powers, that are called naturall faculties: the which howsoever in their particulars they be manifold in a living creature, yet whensoever any of them is resolved, it appeareth to be compounded of some of these five; to wit, the attractive, the retentive, the secretive the concoctive, and the expulsive faculty.

Of which, the attractive, the secretive, and the concoctive do not seeme to belong unto the nerves, for although we may conceive that the part of the animall doth turne it selfe towards the thing which it attracteth; nevertheless, that very turning seemeth not to be done by vertue of the muscles, and of the nerves, but rather in a naturall way, as the motion of the heart is performed, in such sort as we have formerly declared: as for example, if the stomack when it is greedy of meate, draweth it selfe up towards the throate, it seemeth rather to be a kind of dryenesse and of warping, such as we see in bladders or in leather either by fire or by cold, which make them shrivell up and grow hard; then that it is a true faculty of the living creature to seeke after meate.

4. How the attractive and secretive faculties worke.

Nor need we extend our discourse any further about these three faculties; seeing that we have already declared in common, how attraction, drying, and mixture of active bodies with passive ones, is performed; which needeth but applying unto these particulars, to explicate fully their natures: as for example;

if the Kidneyes draw the matter of Vrine unto them out of the Veines, it may be by any of the following three manners, to wit, either by draught, wet, or by ſteame. For if the ſerous parts that are in the bloud which runneth in the Veines, do touch ſome dry parts conformable to their nature, tending towards the Kidneyes; they will infallibly adhere more to thoſe dry parts, then to the reſt of the bloud. Which if they do in ſo great a quantity, that they reach to other further parts more dry then theſe, they will leave the firſt parts to go to the ſecond: and thus by little, and little, will draw a line of Vrine from the bloud, if the bloud do abound with it: and the neerer it commeth to the Kidneyes, the ſtronger ſtill the attraction will be.

The like will happen, if the ſeroſity which is in the bloud, do touch ſome part wetted with a like ſeroſity, or where ſuch hath lately paſſed; for as we ſee that water will run more eaſily upon a wet part of a board or a ſtone then upon a dry one; ſo you cannot doubt, but that if the ſerous part, which is mixed with the bloud, do light upon a current of its own nature, it will ſtick more to that, then to the current of the bloud; and ſo part from the bloud, to goe that way which the current of its own nature goeth.

Beſides, it cannot be doubted, but that from the Kidneyes, and from the paſſages between the Kidneys and the Veines, in which the bloud is conveyed, there ariſeth a ſteame: whoſe nature is, to incorporate it ſelfe with ſerous matter, out of whoſe body it hath been extracted. This ſteame therefore, flying ſtill to the ſerous bloud which paſſeth by, muſt of neceſſity precipitate (as I may ſay) the ſerous parts of that bloud; or rather muſt filter them out of their maine ſtock; and ſo will make them run in that current, from which it ſelfe doth flow. And thus you ſee how *Attraction* and *Secretion* are made: for the drawing of the ſeroſity without drawing the bloud, is the parting of the Urine from the bloud. And this example, of the Kidneys operation, may be applyed to the attractions of all the other parts.

5. Concerning the concoctive faculty.

Now the concoctive faculty (which is the laſt of the three we took together) conſiſteth of two parts: the one is, as it were a drying of the humour, which is to be concocted; the other is,

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a mingling the substance of the vessell in which the humour is concocted, with the humour it selfe: for as if you boyle divers kinds of liquors in brasse pannes, the pannes will taynt the liquor with the qua ity of the brasse; and therefore Physitians forbid the use of such, in the boyling of severall medicines: so much more in a living creatures body, there can be no doubt, but that the vessell in which any humour is concocted, doth give a tincture thereunto. Now concoction consisting in these two, it is evident, what the concoctive vertue is; to wit, heate, and the specificall property of the vessell which by heate is mingled with the humour.

6. Concerning the retentive and expulsive faculties.

There remaine yet, the retentive and the expulsive faculties to be discoursed of; whereof one kind, is manifestly belonging to the voluntary motion which we have declared: namely, that retention, and that expulsion, which we ordinarily make of the grosse excrements either of meate, or of drinke, or of other humours, either from our head, or from our stomacke, or from our Lungs; for it is manifestly done, partly by taking in of winde, and partly by compressing of some parts and opening of others: as Galen sheweth in his curious book *de usu partium*.

An other kind of retention and expulsion: in which we have no sense when it is made, (or if we have, it is of a thing done in us without our will, though peradventure we may voluntarily advance it) is made by the swelling of fibers in certaine parts, through the confluence of humours to them, (as in our stomack it happeneth, by the drink and the juice of the meate that is in it) which swelling, closeth up the passages by which the contained substance should go out (as the moystening of the strings, and mouth of a purse, almost shutteth it) untill in some (for example, the stomack, after a meale) the humour being attenuated by little and little, getteth out subtilely; and so leaving lesse weight in the stomack, the bag which weigheth down lower, then the neather Orifice at which the digested meate issueth, riseth a little: and this rising of it is also furthered by the wrinkling up and shortning of the upper part of the stomack; which still returneth into its naturall corrugation, as the masse of liquid meate leaveth soaking it (which it doth by degrees, still as more and more goeth out; and so what remaineth filleth lesse place,

and reacheth not so high of the stomacke: and thus at length, the residue and thicker substance of the meat, after the thinnest is got out in steame, and the middling part is boyled over in liquor, commeth to presse and gravitate wholly upon the orifice of the stomacke; which being then helped by the figure and lying of the rest of the stomacke, and its strings and mouth relaxing, by having the juice which swelled them, squeezed out of them; it openeth it selfe, and giveth way unto that which lay so heavy upon it, to tumble out. In others (for example, in a woman with child) the enclosed substance, (retained first by such a course of nature as we have set down) breaketh it selfe a passage by force, and openeth the orifice at which it is to goe out by violence, when all circumstances are ripe according to natures institution.

7. Concerning expulsion made by Physicke.

But yet there is the expulsion which is made by physicke, that requireth a little declaration. It is of five kinds: vomitting, purging by stoole, by urine, sweating, and salivation. Every one of which, seemeth to consist of two parts, namely, the disposition of the thing to be purged, and the motion of the nerves or fibers for the expulsion: as for example, when the Physitian giveth a purge, it worketh two things: the one is, to make some certaine humour more liquid and purgeable then the rest; the other is, to make the stomacke or belly, sucke or vent this humour. For the first, the property of the purge must be to precipitate that humour out of the rest of the blood; or if it be thicke, to dissolve it that it may runne easily. For the second, it ordinarily heateth the stomacke; and by that meanes it causeth the stomacke to sucke out of the veines, and so to draw from all parts of the body. Besides this, it ordinarily filleth the belly with winde, which occasioneth those gripings men feele when they take physick; and is cause of the guts discharging those humours, which otherwise they would retaine.

The like of this happened in salivation; for the humours are by the same means brought to the stomack, and thence sublimed up to be spitten out: as we see in those, who taking Mercury into their body, either in substance or in smoke, or by application, doe vent cold humours from any part; the Mercury rising from all the body up to the mouth of the patient, as to the helm

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of a ſublimatory: and the like ſome ſay of Tobacco.

As for vomiting, it is in a manner wholly the operation of the fibers, provoked by the feeling of ſome inconvenient body, which maketh the ſtomacke wrinkle it ſelfe, and work and ſtrive to caſt out what offendeth it.

Sweating ſeemeth to be cauſed, by the heating of ſome introus body by the ſtomacke; which being of ſubtile parts, is by heat diſperſed from the middle to the circumference; and carrieth with it light humours, which turne into water as they come out into the ayre. And thus you ſee in generall, and as much as concerneth us to declare, what the naturall faculties are: and this, according to Galen his owne mind: who affirmeth, that theſe faculties do follow the complexion, or the temper of the parts of a mans body.

How the brain is moved to worke voluntary motion.

Having explicated how voluntary motion proceedeth from the braine: our next conſideration ought to be, to examine what it is, that ſuch an object, as we brought, by meanes of the ſenſes, into the braine from without, doth contribute to make the braine apply it ſelfe to worke ſuch voluntary motion. To which purpoſe, we will goe a ſtep or two backe, to meet the object at its entrance into the ſenſe; and from thence accompany it in all its journey and motions onwards. The object which ſtriketh at the ſenſes dore, and getting in, mingleth it ſelfe with the ſpirits it findeth there; is either conforme and agreeable to the nature and temper of thoſe ſpirits, or it is not: that is to ſay, in ſhort, it is either pleaſing or diſpleaſing to the living creature: or it may be of a third kind, which being neither of theſe, we may terme indifferent. In which ſort ſoever the object affect the ſenſe, the ſpirits carry it immediately to the braine, unleſſe ſome diſtemper or ſtrong thought, or other accident hinder them.

Now, if the object be of the third kind; that is, be indifferent; as ſoone as it hath ſtrucken the braine, it reboundeth to the circle of the memory: and there, being ſpeedily joyned to others of its owne nature, it findeth them annexed to ſome pleaſing or diſpleaſing thing, or it doth not: if not, in beaſts it ſerveth to little uſe: and in men, it remaineth there untill it be called for: but if, either in its owne nature, it be pleaſing or diſpleaſing; or afterwards in the memory it became

became joyned to some pleasing or annoying fellowship; presently, the heart is sensible of it: for the heart being joyned to the braine by straight and large nerves, full of strong spirits which ascend from the heart; it is impossible, but that it must have some communication with those motions, which passe in the braine: upon which the heart, or rather the spirits about it, is either dilated or compressed.

And these motions, may be either totally of one kind, or moderated, and allayed by the mixture of its contrary: if of the former sort; one of them wee call *joy*, the other *griefe*; which doe continue about the heart (and peradventure doe oppresse it, if they bee in the utmost extremity) without sending any due proportion of spirits to the braine, untill they settle a little, and grow more moderate.

Now, when these motions are moderate, they immediately send up some aboundance of spirits to the braine: which if they be in a convenient proportion, they are by the braine thrust into such nerves as are fit to receive them: and swelling them, they give motion to the muscles and tendons that are fastned to them: and they doe move the whole body, or what part of it is under command of those nerves, that are thus filled and swelled with spirits by the braine.

If the object was conformable to the living creature, then the braine sendeth spirits into such nerves, as carry the body to it: but if otherwise, it causeth a motion of aversion or flight from it. To the cause of this latter, we give the name of *Feare*: and the other, that carrieth one to the pursuit of the object, we call *Hope*. *Anger*, or *Audacity*, is mixed of both these; for it seeketh to avoide an evill by embracing and overcomming it: and proceedeth out of abundance of spirits.

Now, if the proportion of spirits sent from the heart, be too great for the braine, it hindereth or perverteth the due operation both in man and beast.

9. Why pleasing objects do dilate the spirits and displeasing ones contract them.

All which it will not be amisse to open a little more particularly: and first, why painfull or displeasing objects, doe contract the spirits, and gratefull ones, doe contrarywise dilate them? It is, because the good of the heart consisteth in life, that is in heat & moysture: and it is the nature of heat, to dilate it self

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in moysture; whereas cold and dry things, doe contract the bodies they worke upon: and such are enemies to the nature of men and beasts: and accordingly experience, as well as reason, teacheth us, that all objects, which be naturally good, are such as be hot and moyst in the due proportion to the creature that is affected and pleased with them.

Now, the living creature being composed of the same principles as the world round about him is; and the heart being an abridgement of the whole sensible creature; and being moreover full of blood, and that very hot; it commeth to passe, that if any of these little extracts of the outward world, doe arrive to the hot blood about the heart, it worketh in this blood such like an effect, as we see a drop of water falling into a glasse of wine, which is presently dispersed into a competent compasse of the wine: so that any little object must needs make a notable motion in the blood about the heart.

This motion, according to the nature of the object, will be either conformable or contrary; unlesse it be so little a one, as no effect will follow of it; and then, it is of that kinde, which above we called indifferent. If the ensuing effect be connaturall to the heart, there riseth a motion of a certaine fume about the heart; which motion we call *pleasure*; and it never fayleth of accompanying all those motions which are good, as *Ioy*, *Love*, *Hope* and the like: but if the motion be displeasing; there is likewise a common sense of a heavinesse about the heart, which we call *griefe*: and it is common to *sorrow*, *feare*, *hate*, and the like.

Now it is manifest by experience, that these motions are all of them different ones, and doe strike against divers of those parts of our body which encompasse the heart: out of which striking followeth that the spirits sent from the heart, doe affect the braine diversly; and are by it it, conveyed into divers nerves: and so doe set divers members in action. Whence followeth, that certaine members are generally moved upon the motion of such a passion in the heart, especially in beastes, who have a more determinate course of working, then man hath: and if sometimes wee see variety, even in beastes, upon knowledge of the circumstances, wee may easily guesse at the causes of that variety: the particularities

rities of all which motions, we remit to Phyſitians and to Anatomiſts: advertiſing onely, that the fume of pleaſure, and the heavineſſe of griefe, doe plainly ſhew, that the firſt motions doe participate of dilatation, and the latter of compreſſion.

10 Concerning the five ſenſes of what uſe and end they are.

Thus you ſee, how by the ſenſes, a living creature becommeth judge of what is good, and of what is bad for him: which operation, is performed more perfectly in beaſts; and eſpecially in thoſe, who live in the free ayre, remote from humane converſation (for their ſenſes are freſh and untaynted, as nature made them) then in men. Yet without doubt nature hath heen as favourable in this particular to men, as unto them: were it not, that with diſorder and exceſſe, we corrupt and oppreſſe our ſenſes: as appeareth evidently by the ſtory we have recorded of John of Leige: as alſo by the ordinary practice of ſome Hermites in the deſerts, who by their taſte or ſmell, would preſently be informed whether the herbes, and roots, and fruits they met withall, were good or hurtful for them, though they never before had had triall of them.

Of which excellency of the ſenſes, there remaineth in us onely ſome dimme ſparkes, in thoſe qualities which we call ſympathies and antipathies: whereof the reaſons are plaine, out of our late diſcourſe: and are nothing elſe, but a conformity or oppoſition of a living creature, by ſome individuall property of it, unto ſome body without it: in ſuch ſort, as its conformity or oppoſition unto things by its ſpecifiall qualities, is termed naturall or againſt nature. But of this we ſhall diſcourſe more at large hereafter.

Thus it appeareth, how the ſenſes are ſeated in us, principally for the end of moving us to, or from objects, that are good for us, or hurtfull to us. But though our Reader be content to allow this intent of nature, in our three inferiour ſenſes; yet he may peradventure not be ſatisfied, how the two more noble ones (the hearing and the ſeeing) doe cauſe ſuch motions to, or from objects, as are requiſite to be in living creatures for the preſervation of them: for (may he ſay) how can a man, by onely ſeeing an object, or by hearing the ſound of it, tell what qualities it is imbued withall? Or what motion of liking or diſliking, can be cauſed in his heart, by his meere receiving the viſible

ble ſpecies of an object at his eyes, or by his eares hearing ſome noiſe it maketh? And if there be no ſuch motion there, what ſhould occaſion him, to proſecute or avoyd that object? When he taſteth, or ſmelleth, or toucheth a thing, he findeth it ſweet, or bitter or ſtinking, or hot, or cold; and is therewith either pleaſed or diſpleaſed: but when he onely ſeeth or heareth it, what liking or diſliking can he have of it, in order to the preſervation of his nature?

The ſolution of this difficulty, may in part appeare out of what we have already ſaid. But for the moſt part, the objects of theſe two nobler ſenſes doe move us, by being joyned in the memory with ſome other thing that did either pleaſe or diſpleaſe ſome of the other three ſenſes. And from thence it is, that the motion of going to imbrace the object, or averſion from it, doth immediately proceed: as when a dog ſeeth a man that uſeth to give him meat, the ſpecies of the man coming into his fanſie, calleth out of his memory the others which are of the ſame nature, and are former participations of that man, as well as this freſh one is: but theſe are joyned with ſpecieſes of meate, becauſe at other times they did uſe to come in together: and therefore the meate being a good unto him, and cauſing him (in the manner we have ſaid) to move towards it; it will follow that the dog will preſently move towards that man, and expreſſe a contentednesſe in being with him. And this is the ground of all aſſuefaction in beaſts, and of making them capable of receiving any inſtructions.

## THE FIVE AND THIRTIETH CHAPTER.

### *Of the materiall inſtruments of Knowledge and Paſſion; of the ſeverall effects of Paſſions; of Paine and Pleaſure; and how the vitall ſpirits are ſent from the brain into the intended parts of the body, without miſtaking their way.*

TO conclude this great buſineſſe, which concerneth all the mutations and motions, that are made by outward Agents in a living creature, it will not be amiſſe, to take a ſhort and generall ſurvey of the materiall inſtruments, which concur

1 That *Septum Lucidum* is the ſeat of the fanſie.

concur to this effect. Whereof the braine being the principall, or at least, the first and next of the principals; we may take notice that it containeth, towards the middle of its substance, foure concavities, as some doe count then: but in truth, these foure, are but one great concavity, in which foure, as it were, divers roomes, may be distinguished. The neather part of these concavities, is very unequall, having joyned unto it, a kind of net, wrought by the entangling of certain little arteries, and of small emanations from a *Sinus*, which are interwoven together. Besides this, it is full of kernels, which do make it yet more uneven.

Now, two rooms of this great concavity, are divided by a little body, somwhat like a skin, (though more fryable) which of it selfe is cleare; but there it is somewhat dimmed, by reason that hanging a little slacke, it somewhat shriveleth together: and this, Anatomists do call *Septum lucidum*, or *speculum*; and is an indifferent body from all the rest that are in the braine. This transparent body hangeth as it were straightwards from the forehead towards the hinder part of the head: and divideth the hollow of the brain, as far as it reacheth, into the right and the left ventricles.

This part seemeth to me, (after weighing all circumstances and considering all the conveniences, and fitnesses) to be that, and onely that, in which the fansie or common sense resideth: though Monsieur des Cartes hath rather chosen a kernell to place it in. The reasons of my assertions are; first, that it is in the middle of the braine, which is the most convenient situation to receive the messages from all our body, that doe come by nerves, some from before, and some from behind. Secondly, that with its two sides, it seemeth to be conveniently opposed to all such of our senses, as are double; the one of them sending its little messengers or atomes, to give it advertisements on one side, the other on the other side; so that it is capable of receiving impression indifferently from both. Againe, by the nature of the body, it seemeth more fit to receive all differences of motion, then any other body neer it. It is also most conformable to the nature of the eye; which being our principal outward sense must needs be in the next degre to that, which is elevated a strain above our outward senses. Fiftly, it is of a single and peculiar nature, whereas the kernels are many, and all of them of the same

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condition, quality and appearance. Sixtly, it is seated in the very hollow of the braine; which of necessity must be the place and receptacle where the species and similitudes of things doe reside; and where they are moved and tumbled up and down, when we think of many things. And lastly, the situation wee put our head in, when we think earnestly of any thing, favoureth this opinion: for then we hang our head forwards, as it were forcing the species to settle towards our forehead, that from thence they may rebound, and worke upon this diaphanous substance.

2. What causeth us to remember not only the object it self, but also that we have thought of it before.

This then supposed, let us consider, that the atomes or likenesses of bodies, having given their touch upon this *Septum* or *Speculum*, doe thence retire back into the concavities, and doe sticke (as by chance it happeneth) in some of the inequalities they encounter with there. But if some winde or forcible steame, should breake into these caves, and as it were brush and sweepe them over; it must follow, that these little bodies wil loosen themselves, and begin to play in the vapour which filleth this hollow place: and so floting up and down, come anew to strike and worke upon the *Speculum* or fantasy: which being also a soluble body, many times these atomes striking upon it, do carry some little corporeall substance from it sticking upon them: whence ensueth, that they returning again with those tinctures or participations of the very substance of the fantasy; do make us remember, not only the objects themselves, but also that wee have thought of them before.

3. How the motions of the fantasie, are derived to the heart.

Further we are to know, that all the nerves of the braine, have their beginnings not farre from this *speculum*: of which we shall take a more particular consideration of two, that are called the sixt paire or couple: which pair hath his singularity, that it beginneth in a great many little branches, that presently grow together, and make two great ones contained within one skin. Now this being the property of a sense (which requireth to have many fibers in it, to the end that it may be easily and vigorously strucken, by many parts of the object lighting upon many parts of those little fibers) it giveth us to understand, that this sixt couple hath a particular nature, conformable to the nature of an externe sense, and that the Architect who placed it there, intended by the severall conduits of it, to give notice unto some part they goe unto, of what passeth in the braine: and accordingly

dingly one branch of this nerve, reacheth to the heart; not only to the Pericardium, as Galen thought, but even to the very substance of the heart it self, as later Anatomists have discovered: by which we plainly see how the motion which the senses doe make in the *Speculum*, may be derived downe to the heart.

4 Of paine and pleasure.

Now therefore let us consider, what effects the motions so conveyed from the braine, will worke in the heart. First remembring how all that moveth the heart, is either paine or pleasure (though we doe not use to call it paine, but grief, when the evill of sense moveth us only by memory, and not by being actually in the sense) and then calling to minde, how paine (as Naturalistes teach us) consisteth in some division of a nerve, (which they call *Solutio continui*: and must be in a nerve; for that no solution can be the cause of paine, without sense, nor sense be without nerves; and therefore this solution must needs be in nerves, to have it prove painfull,) we may conclude, that the effect which we call paine, is nothing else but a compression: for although this solution of continuity may seeme to be a dilatation; yet in truth, it is a compression in the part where the evill is, which happeneth unto it in the same manner as wee shewed (when we spoke of the motion of restitution) it doth to stiffe bodies, that by violence are compressed and drawne into a lesse capacious figure, then their nature affecteth, and returne into their owne state, as soon as the mastring violence leaveth them at liberty.

Pleasure therefore, must be contrary to this, and consist in a moderate dilatation; for an immoderate one, would cause a compression in some adherent parts; and there would become paine. And conformable to this, we experience, that generally they are hard things which breed paine unto us; and that these which breed pleasure, are oyly and soft; as meates, and odours, which are sweet to the taste and smell; and soft substances, which are gratefull to the touch: the excesse of all which proveth offensive and painfull; so that from the extremity of pleasure, one entreth presently upon the confines of paine.

Now then let us consider, how the little similitudes of bodies, which from without doe come into the fantasy, must of necessity worke there, according to their little power, effects pro-

proportionable to what they wrought first in the outward senses, from whence, they were conveyed to the braine: for the senses (that is the nerves) and the *Septum lucidum*, having both of them their origine from the very substance of the braine, and differing only in degrees of purity and refinement, the same object must needs worke like effects in both, compressing or dilating them proportionably to one another: which compression or dilatation, is not paine or pleasure, as it is in the outward sense; but as it is reported to the heart: and that, being the seat of all paines or pleasures wrought in other parts, and that (as it were) dyeth them into those qualities, is not capable of feeling either it selfe: so that the strokes of any little similitudes upon the fantasy, do make only compressions or dilatations there, not paines or pleasures.

5. Of Passion.

Now their bodies or similitudes, if they be reverberated from the fantasy or *septum Lucidum*, upon the little roots of the nerves of the sixt couple, which go to the heart, they must needs worke there a proportionable impression to what they wrought upon the fansy, either compressing or dilating it; and the heart being extremely passive, by reason of its exceeding tenderneſſe and heat; cannot choose but change its motion, at the least in part, if not in whole: and this with relation to two causes: the one disposition of the heart it self; the other, the vehemency of the stroak.

This change of motion and different beating of the heat, is that which properly is called passion: and is ever accompained with pleasure or with grief, according to the nature of the impression, that either contracteth or dilateth the heart and the spirits about it: and is discovered by the beating of the arteries and of the pulse. Conformable whereunto, Physitians do tell us, that every passion hath a distinct pulse.

6. Of severall pulses caused by passions.

These pulses are divided in common, by aboundance, or by want of spirits: yet in both kinds, they may have common differences; for in aboundance, the pulse may be quick or slow, regular or irregular, equall or unequall: and the like may happen in defect of spirits; accordingly to the motions of the heart, which are their causes. Againe, the object by being present or further off, maketh the stroak greater or lesser: and accordingly, varieth the motion of the heart.

Let us then call to mind, how wee have formerly declared,

that life consisteth in heat and humidity, and that these two joyned together, doe make a thing great: and wee may conclude that of necessity the motion which is most lively, must have a great, full, and large stroake; like the even rolling waves of a wide and smooth sea; and not too quick or smart, like the breaches of a narrow *Fretum*, agitated by tempestuous windes. From this, other motions may vary either by excesse, or by deficiency: the first maketh the stroake become smart, violent and thicke: the other slackeneth it, and maketh it grow little, slow, weake, and thinne, or seldome.

And if we looke into the motions of our heart, wee shall see these three differencies of them, follow three severall chiefe passions. The first, followeth the passion of joy: the second, the passion of anger: and the third, the passion of griefe. Nor neede we looke any further into the causes of the severall motions; for we see that joy and griefe, following the stroake of sense, the one of them must consist in an oyly dilatation: that is, the spirits about the heart, must be dilated by a gentle, large, great, and sweet motion, in a moderation between velocity and slowneſſe: the other contrariwise, following the stroak of sense in paine, as the first did in pleasure, must contract the spirits; and consequently make their motion or stroak become little, and deficient from all the properties we have above set down.

As for anger, the motion following that passion, is, when the aboundance of spirits in the heart is a little checked by the contrary stroak of sense, but presently overcommeth that opposition: and then, as we see a hindered water, or a man, that suddainly or forcibly break through what withstood their motion, go on with a greater violence then they did, and as it were precipitately: so the heart, having overcome the contraction, which the sense made in it, dilateth it selfe with a fury, and maketh its motion smart and vehement. Whence also it followeth, that the spirits grow hotter then they were: and accordingly, it is often seen, that in the scoulding of a woman, and in the irritation of a dog, if ever now & then, one thwart them, and interpose a little opposition, their fury will be so sharpened and heightened, that the woman will be transported beyond all limits of reason, and the dog will be made mad with nothing else done to him, but angring him at convenient times: and

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ſome men likewiſe, have by ſleight oppoſitions, iterated ſpeedily upon them, before their ſpirits could relent their vehement motion (and therefore, muſt ſtill encreaſe it) been angred into feavers.

This paſſion of anger, ſeemeth almoſt to be ſolitary on the ſide of exceſſe beyond joy: which is, as it were the ſtandard and perfection of all paſſions; as light or whiteneſſe, is of all colours: but on the other ſide, of deficiency, there are ſeverall middle paſſions, which participate more or leſſe of joy and grief: as particularly thoſe two famous ones, which governe mans life, *Hope* and *Feare*. Concerning which, Phyſitians tell us, that the pulſe or beating of feare, is quick, hard, and unequall: unto which I conceive we may ſafely adde, that it muſt alſo be ſmall and feeble; the perfection of joy, decreaſing in it on one ſide, to wit, from greatneſſe and largeneſſe; but not intirely; ſo that a kind of quickneſſe ſupplyeth in part the other defect. Hope on the other ſide, is in ſuch ſort defective from joy, that nevertheleſſe it hath a kind of conſtancy, and moderate quantitie, and regularity in its motion: and therefore is accounted to be the leaſt hurtfull of all the paſſions, and that which moſt prolongeth mans life. And thus you ſee how thoſe motions, which wee call paſſions, are engendered in the heart, and what they are.

7. Of ſeverall other effects cauſed naturally in the body by paſſions.

Let us then in the next place conſider, what will follow in the reſt of the body, out of theſe varieties of paſſions, once rayſed in the heart, and ſent into the braine. It is evident, that according to the nature and quality of theſe motions, the heart muſt needs in every one of them, voyde out of it ſelf into the arteries, a greater or leſſer quantity of blood, and that in divers faſhions: and the arteries which lie fitteſt to receive theſe ſudden egeſtions of blood are thoſe which goe into the braine: whoſe courſe being directly upwards, we cannot doubt, but that it is the hotteſt and ſubtileſt part of the blood, and the fulleſt of ſpirits, that flyeth that way. Theſe ſpirits then running a long and perplexed journey up and down in the braine, by various meanders and anfractuoſities, are there mingled with the humide ſteame of the braine it ſelfe, and are therewith cooled; and doe come at the laſt, to ſmoake at liberty in the hollow ventricles of the braine, by reeking out of the little arteriall branches, that doe weave the *plexus choroides*, or net we ſpoke of erewhile: and they

they being now growne heavy, doe fall (by their naturall course) into that part or processe of the braine, which is called *medulla spinalis*, or the marrow of the back bone: which being all beset by the nerves that run through the body, it cannot happen otherwise, but that these thickened and descending spirits, must either fall themselves into those nerves, or else presse into them other spirits which are before them, that without such new force to drive them violently forwards, would have slided downe more leisurely. Now, this motion being downwards, and meeting with no obsticle till it arrive unto its utmost periode that way, the lowest nerves are these, which naturally doe feele the communication of these spirits first.

But it is true, if the flowing tide of them be great and plentifull, all the other nerves will also be so suddenly filled, upon the filling of the lowermost, that the succession of their swellings, will hardly be perceptible: as a sudden and violent inundation of water, seemeth to rise on the sides of the channell, as it doth at the mill-damme; though reason assureth us it must beginne there, because there it is first stopped.

On the contrary side, if the spirits be few, they may be in such a proportion, as to fill only the lower nerves, and to communicate little of themselves to any of the others. And this is the case in the passion of fear: which being stored with fewer spirits, then any other passion that causeth a motion in the body, it moveth the legges most; and so carrieth the animal that is affrayd, with violence from the object that affrighteth him. Although in truth, it is a faint hope of escaping, mingled with fear, which begetteth this motion: for when fear is single, and at its height, it stoppeth all motion by contracting the spirits, and thence is called *stupor*; as well as grief, for the same reason: and accordingly we see extreame cowardes in the extremity of their fear, have not the courage to runne away, no more then to defend or help themselves by any other motions.

But if there be more abundance of spirits; then the upper-parts are also moved, as well as the legges; whose motion contributeth to defense: but the brain it self, and the senses which are in the head, being the first in the course of this flood of spirits, that is sent from the heart to the head; it is impossible but that some part of them, should be pressed into the nerves of those

senses;

ſenſes; and ſo will make the animal vigilant and attentive to the cauſe of its feare or griefe.

But if the feare be ſo great, that it contracteth all the ſpirits, and quite hindereth their motion (as in the caſe wee touched above) then it leaveth alſo the nerves of the ſenſes deſtitute of ſpirits; and ſo by too ſtrong apprehenſion of a danger, the animal neither ſeeth nor apprehendeth it: but as eaſily precipitateth it ſelf into it, as it happeneth to avoyde it; being meerly governed by chance; and may paradventure ſeeme valiant, through extremity of feare.

And thus you ſee in common, how all the naturall operations of the body, doe follow by naturall conſequence out of the paſſions of the minde: without needing to attribute diſcourſe or reaſon, either to men or beaſtes to performe them. Although at the firſt ſight, ſome of them may appeare unto thoſe that look not into their principles and true cauſes, to flow from a ſource of intelligence: whereas it is evident by what we have layed open, they all proceed from the due ranging and ordering of quantitative parts, ſo or ſo proportioned by rarity and denſity. And there is no doubt, but who would follow this ſearch deeply, might certainly retrive the reaſons of all thoſe externall motions which we ſee uſe to accompany the ſeverall paſſions in men and Beaſtes. But for our intent, we have ſaid enough, to ſhew by what kind of order and courſe of nature, they may be effected (without confining our ſelves over ſcrupulouſly to every circumſtance that we have touched) and to give a hint, whereby others that will make this inquiry their taske, may compile an intire, and well grounded and intelligible doctrine of this matter.

Only we will adde one advertiſement more; which is, that theſe externall motions cauſed by paſsion, are of two kindes: for ſome of them are as it were the beginnings of the actions, which nature intendeth to have follow out of the paſsions that cauſe them: but others are not onely bare ſignes of paſſion that produce them, and are made by the conneixon of parts unneceſſary for the maine action that is to follow out of the paſſion, with other parts that by the paſſion are neceſſarily moved: as for example, when an hungry mans mouth watereth at the ſight of good meate, it is a kinde of beginning of eating, or of prepa-

ration for eating: for when we eate, nature draweth a moysture into our mouth, to humectate our meate, and to convey the taſt of it into the nerves of the tongue, which are to make report of it unto the braine: but when we laugh, the motion of our face aymeth at no further end, and followeth only by the connexion of thoſe muſcles, which draw the face in ſuch a ſort, unto ſome inward parts, that are moved by the paſſion, out of which laughing proceedeth.

8. Of the Diaphragma.

But we muſt not leave this ſubject without ſome mention of the diaphragma: into which the other branch of thoſe nerves, that are called of the ſixt conjugation, doth come: for the firſt branch we have ſaid goeth into the heart, and carrieth thither the objects that come into the braine: and this, we ſhall find, carrieth back to the braine the paſſion or motion, which by the object is rayſed in the heart. Concerning this part of our body, you are to note, that it is a muſculous membrane, which in the middle of it hath a ſinewy circle; whereunto is faſtened the eaſe of the heart, called the pericardium. This Diaphragma is very ſenſible, receiving its vertue of feeling from the above mentioned branch of the ſixt couple of nerves: and being of a trembling nature, is by our reſpiration kept in continuall motion: and flappeth upon all occaſions, as a drum head would do, if it were ſlack and moyſt; or as a ſayle would do, that were brought into the wind.

Out of this deſcription of it, it is obvious to conceive, that all the changes of motion in the heart, muſt needs be expreſſed in the Diaphragma. For the heart beating upon the pericardium, and the Pericardium being joyned to the Diaphragma; ſuch jogges and vibrations muſt needs be imprinted and echoed there, as are formed in the heart: which from thence, cannot chooſe but be carried to the braine by the ſixt couple of nerves. And thus it commeth about, that we feele and have ſenſation of all the paſſions, that are moved in our heart. Which peradventure is the reaſon, why the Greekes do call this part φρένες; and from it derive the verbe φρονεῖν, that in Latine ſignifyeth *Sapere*, with us, to ſavour or to like: for by this part of our body, we have a liking of any object, or a motion of inclination towards it: from whence σωφρονεῖν is derived, by compoſition of φρονεῖν, with σάος: for a prudent man is he, that liketh, and is moved

moved to compasse wholesome and good things. Which Etymology of the word, seemeth unto me more naturall, then from the phrenesy, from whence some derive it; because a great distemper or inflammation in the Diaphragma, often causeth that disease.

9. Concerning paine and pleasure caused by the memory of things past.

Now, because the object is conveyed from the braine to the heart some part of its way, by the same passage, as the motion of the heart is reconveyed back to the braine, it must of necessity follow, that who is more attentive to outward sense, doth lesse consider or reflect upon his passion; and who is more attentive to observe, and be governed by what passeth in his heart, is lesse wrought upon by externall things. For if his fantasy draweth strongly unto it, the emanations from outward agents upon the senses, the streame of those emanations will descend so strongly from the overfilled fantasy into the heart, that it will hinder the ascent of any fewer and weaker spirits by the same pipe. But if the current do set strongest upwards, from the heart by the Diaphragma to the braine, then it will so fill the pipe by which it ascendeth, that little of a weaker tyde can make a contrary eddy water in the same channell.

And by this meanes, nature effecteth a second pleasure or paine in a living creature, which moveth it (oftentimes very powerfully) in absence of the primary object: as we may observe, when thinking of any pleasing or displeasing action, we find about our heart a motion which enticeth us to it or averteth us from it: for as the first pleasure was occasioned by the stroake, which the object applyed to the outward sense, made upon the fantasy, (which can judge of nothing without being strucken by it) so the second pleasure springeth from the spirits moved in the heart, by messengers from the braine, which by the Diaphragma do rebound a stroake back againe upon the fantasy. And from hence it proceedeth, that memory delighteth or afflicteth us; and that we think of past things with sweetnesse or with remorse: and thereby assuefaction is wrought in beasts, as farre as the appetitive part doth contribute thereunto, to perfect what was begun in their cognoscitive part, by the ingression of corporeal especieses into their fantasy, in order to the same effect, as we have touched before.

10. How so small bodies as atomes are, can cause so great motions in the heart.

But now let us examine, how so small a quantity of a body, as cometh from an object into our sense, can be the cause of so great

a motion about our heart. To which purpoſe we are to remember, that this motion is performed in the moſt ſubtile and thin ſubſtance, that can be imagined: they are the vitall ſpirits, that do all this work; which are ſo ſubtile, ſo agile, and ſo hot, that they may in ſome ſort be termed fire. Now if we reflect how violent fire is, we need not wonder at the ſuddaine and great motion of theſe paſſions.

But we muſt further take notice, that they are not in the greateſt exceſſe, but where the living creature hath been long inured and exerciſed unto them, either directly or indirectly: ſo that they arrive not to that pitch ſo much out of the power of the agent, as out of the preparation and diſpoſition of the patient; as when cold water hath been often heated by extinguiſhing red hot irons in it, after ſome repetitions a few quenchings will reduce it from cold to boyling, that at the firſt would ſcarce have made it lukewarme: and accordingly we ſee a heart, that for a long time hath loved, and vehemently hath deſired enjoying, is tranſported in a high degree, at the leaſt ſight and renuance of ſtroaks from its beloved object; and is as much dejected, upon any the leaſt deprivation of it: for to ſuch an object, the living creature is hurried away by a force much reſembling the gravity or celerity of a denſe body, that is ſet on running down a ſteepe hill; unto which, the onely taking away of a weake let or the leaſt ſtop, giveth a precipitate courſe, not out of the force of what is done to it, but out of the force which was formerly in the thing, though for the preſent it lay there undiſcovered: and ſo likewiſe in theſe caſes, the object rather giveth the occaſion of the violent motion, then the force or power to it.

How the vitall ſpirits ſent from the brain, doe run to the intended part of the body without miſtake.

Theſe things being thus determined, ſome peradventure may aske, how it commeth to paſſe, that the ſpirits which cauſe motion, being ſent on their arrant by the braine, do alwayes hit the right way, and light duly into thoſe very ſinewes, which move the living creature according as is requiſite for its nature? Since all the paſſages are open, what is it that governeth them, ſo as they never miſtake, and the animall is never driven towards harme, in ſteed of flying from it? Who is their guide in theſe obſcure paths? But it were to impute ignorance to the maker, to think that he framed all the paſſages alike, and ſo every one of them

them, promiſcuouſly apt to receive into them, all ſorts of ſpirits, howſoever they be moved: and therfore, we may aſſure our ſelves that ſince in theſe diverſities of occaſions, there are likewiſe divers kinds of motions from the heart; either there is proportionable unto them, divers kinds of paſſages fit to receive and entertaine the ſpirits, according to the condition they are in, ſo as the paſſages which are ajuſted to one kind of ſpirits, will not admit any of an other nature: or elſe, the firſt motions of liking or diſliking in the heart, which (as we have ſaid) do cauſe a ſwelling or a contraction of it againſt this or that part; doth ſtop and hinder the entrance of the ſpirits into ſome ſinews, and doth open others, and driveth the ſpirits into them: ſo as in the end, by a reſult of a chaine of ſwellings and contractions of ſeverall parts ſucceſſively one againſt an other, the due motions of proſecution or averſion are brought about.

As for example; an object that affecteth the heart with liking, by dilating the ſpirits about the heart, ſendeth ſome into the optik nerves, and maketh the living creature turne his eye towards it and keepe it ſteady upon what he deſireth: as contrariwiſe, if he diſlike and feare it, he naturally turneth his eye and head from it. Now, of this motion of the eye and head, may depend the running to the thing in one caſe, and the running from it in the other: for the turning of the neck one way, may open a paſſage for the ſpirits into thoſe ſinewes, which carry the reſt of the body towards the object: and the turning of it to the other ſide, may open other ſinewes, which ſhall work a contrary effect, and carry the animall from the object: and the moving of thoſe ſinewes, which at the firſt do turne the neck, doth proceed from the quality and number of the ſpirits that aſcend from the heart, and from the region of the heart from whence they are ſent: according to the variety whereof, there are divers ſinewes fitted to receive them.

To make up which diſcourſe, we may call to mind, what we have ſaid a little above, concerning the motions cauſed in the external parts of the body, by paſſion moving within: as when feare mingled with hope, giveth a motion to the legs, anger to the armes & hands, and all the reſt of the body, as well as to the legs; and all of them an attention in the outward ſenſes; which nevertheleſſe perverteth everyone of their functions, if the paſſion be in extremity

And

And then ſurely, we may ſatisfie our ſelves, that either this, or ſome way like it (which I leave unto the curious in Anatomy to ſettle with exactneſſe; for it is enough for my intent, to ſhew in groſſe how theſe operations may be done, without calling in ſome incomprehenſible qualities to our ayd) is the courſe of nature in motions, where no other cauſe interveneth, beſides the object working upon the ſenſe: which all the while it doth, it is the office of the eye of fantaſie or of common ſenſe, to lie ever open; ſtill watching to obſerve what warnings the outward ſenſes doe ſend unto him; that accordingly he may direct and change the motions of the heart and of the whole body.

12 How men are blinded by paſſion.

But if the object do make violent impreſſions upon the ſenſe; and the heart, being then vehemently moved, doe thereupon ſend abundance of ſpirits up to the braine; this multitude of ſpirits thronging upon the common ſenſe, oppreſſeth it (as we have already ſaid) in ſuch ſort, that the notice which the ſenſe giveth of particular circumſtances cannot prevaile to any effect in the braine: and thus by the miſguidance of the heart, the worke of nature is diſordered: which when it happeneth, we expreſſe in ſhort, by ſaying that paſſion blindeth the creature, in whom ſuch violent and diſorderly motions have courſe; for paſſion is nothing elſe, but a motion of the bloud and ſpirits about the heart; and is the preparation or beginning of the animals working; as we have above particularly diſplayed.

And thus you ſee in common, how the circuit is made from the object to the ſenſe; and from it by the common ſenſe and fantaſie, to the heart; and from the heart backe againe to the braine; which then ſetteth on worke thoſe organes or parts the animal is to make uſe of in that occaſion: and they either bring him to, or carry him from the object, that at the firſt cauſed all this motion, and in the end becommeth the period of it.

## THE SIX AND THIRTIETH CHAPTER,

### *Of some actions of beasts, that seem to be formall acts of reason, as doubting, resolving, inventing.*

1 The order and connexion of the subsequent Chapters.

IN the last Chapter the foundations are layd, and the way is opened, for the discovering how all operations which proceed from nature and passion, are performed among living creatures: and therefore, I conceive, I have thereby sufficiently complyed with the obligation of my intention: which is but to expresse and shew in common, how all the actions of sensible bodies may be reduced to locall motion, and to materiall application of one body unto another, in a like manner (though in a different degree) as those motions which we see in liveliest bodies. Yet because among such animals as passe for irrationall, there happen some operations of so admirable a straine, as resemble very much the higheſt effects which proceed from a man: I thinke it not amisse, to give some further light, by extending my discourse to some more particulars then hitherto I have done; whereby the course and way how they are performed, may be more clearely and easily looked into: and the rather, because I have met with some men, who either wanting patience to bestow on thoughts of this kind so much time as is necessary for the due scanning of them; or else through a promptitude of nature, passing swiftly from the effect they looke upon in grosse, to the most obvious seeming cause; do suddenly and strongly resolve, that beasts use discourse upon occasions, and are endewed with reason.

This I intend not to doe quite in particular, for that were to write the history of every particular animal: but will content my selfe with touching the causes in common; yet in such sort, that the indifferent Reader may be satisfied of a possibility, that these effects may proceed from materiall causes: and that I have pointed out the way, to those who are more curious, and have the patience and leisure to observe diligently what passeth among beasts, how they may trace these effects from step to step, untill at length they discover their true causes.

To

To begin then; I conceive we may reduce all those actions of beasts, which seeme admirable, and above the reach of an irrationall animal, unto three or foure severall heads. The first may be of such, as seeme to be the very practice of reason, as doubting, resolving, inventing, and the like. The next shall be of such, as by docility or practise beasts doe oftentimes arrive unto. In the third place, we will consider certaine continuate actions of a long tract of time, so orderly performed by them, as that discourse and rationall knowledge seem clearely to shine through them. And lastly, we will cast our eye upon some others, which seeme to be even above the reason that is in man himselfe, as the knowing of things which the sense never had impression of before, a prescience of future events, providences, and the like.

2 From whence proceedeth the doubting of beasts.

As for the first: the doubting of beasts, and their long wavering sometimes between objects that draw them severall waies, and at the last their resolving upon some one of them, and their steady pursuanee of that afterwards; will not be matter of hard digestion to him, that shall have well relished and meditated upon the contents of the last Chapter: for it is evident, that if severall objects of different natures do at the same time present themselves unto a living creature, they must of necessity make divers impressions in the heart of it, proportionable unto the causes from whence they proceed: so that if one of them be a motion of hope, and the other be of feare; it cannot choose but follow thence, that what one of them beginneth, the other will presently breake off: by which meanes it will come to passe, that in the beasts heart there must needs be such waverings, as we may observe in the sea, when at the beginning of a tide of flood, it meeteth with a banke that checketh the comming in of the waves, and for a while, beateth them backe as fast as they presse upon it; they offer at getting over it, and by and by retire back againe from the steepnesse of it, as though they were apprehensive of some danger on the other side; and then againe attempt it a fresh: and thus continue labouring, one while one way, another while another; untill at the length the flood increasing, the water seemeth to grow bolder, and breaketh amaine over the banke, and then floweth on, till it meeteth with another, that resisteth it, as the first did: and thus you see, how the sea can

doubt

doubt and resolve, without any discoursing. In the like manner it fareth with the heart of a beast (whose motions do steere the rest of the body) when it beateth betwixt hope and feare, or between any other two contrary passions, without requiring any other principles from whence to deduce it, then those we have already explicated.

3. Concerning the invention of Foxes and other beasts.

But now to speake of their invention; I must confesse, that among severall of them, there appeareth so much cunning in laying of their plots (which when they have compassed, they seem to grow careless, and to unbend their intention, as having obtained what with earnestnesse they desired) that one might think they wrought by designe, and had a distinct view of an end; for the effecting of which, they used discourse to choose the likeliest meanes.

To this purpose the subtilties of the fox are of most note. They say he useth to lie as if he were dead; thereby to make hennes and duckes come boldly to him. That in the night when his body is unseen, he will fix his eyes upon poultry, and so make them come downe to him from their roost. That to rid himselfe of the fleas that afflict him in the summer, he will sinke his body by little and little into the water, while the fleas creep up to his head (to save themselves from drowning) and from thence to a bough he holdeth in his mouth; and will then swimme away, leaving them there. That to cosen the badger of his earth, he will pisse in it; as knowing that the ranke smell of his urine, will drive the other cleanlier beast to quit it. That when dogges are close upon him, and catching at him, he will pisse upon his taile, and by firking that up and downe, will endeavour (you may beleeve) to make their eyes smart, and so retard their pursuit, that he may escape from them.

And there are particular stories, that expresse yet more cunning then all these: as of a fox, that being sore hunted, hanged himselfe by the teeth among dead vermine in a warren; untill the dogges were passed by him, and had lost him. Of another, that in like distresse, would take into his mouth a broome bush growing upon a steepe cliffe on the side hand neere his denne (which had another way to it, easie enough of accesse) and by helpe of that, would secure cast himselfe into his

his hole; whiles the dogges that followed him haſtily, and were ignorant of the danger, would breake their necks downe the rockes.

It is ſaid, that in Thracia, the Countrey-people ſo know whether the rivers that are frozen in the winter, will beare them or no, by marking whether the foxes venture boldly over them, or retire after they have layed their eares to the yce, to liſten whether or no they can heare the noyſe of the water running under it: from whence you may imagine they collect, that if they heare the current of the ſtreame, the yce muſt needs be thinne; and conſequently dangerous to truſt their weight unto it.

And to buſie my ſelfe no longer with their ſubtilties, I will conclude with a famous tale of one of theſe crafty animals; that having killed a gooſe on the other ſide of the river, and being deſirous to ſwim over with it, to carry it to his denne, before he would attempt it (leſt his prey might prove too heavy for him to ſwim withall, and ſo he might loſe it) he firſt weighed the gooſe with a piece of wood, and then tryed to carry that over the river, whiles he left his gooſe behind in a ſafe place; which when he perceived he was able to do with eaſe, he then came backe againe, and ventured over with his heavy bird.

They ſay it is the nature of the Iacatray to hide it ſelfe, and imitate the voyce of ſuch beaſts, as it uſeth to prey upon; which maketh them come to him, as to one of their own fellows; and then he ſeiſeth upon them and devoueth them.

The Iaccall, that hath a ſubtile ſent, hunteth after beaſts; and in the chaſe, by his barking guideth the lyon, (whoſe noſe is not ſo good) till they overtake what they hunt; which peradventure would be too ſtrong for the Iaccall; but the Lyon killeth the quarry, and having firſt fed himſelfe, leaveth the Iaccall his ſhare: and ſo between them both, by the ones dexterity, and by the others ſtrength they get meate for nouriſhment of them both.

Like ſtories are recorded of ſome fiſhes. And every day we ſee the invention of beaſts to ſave themſelves from catching: as hares, when they are hunted, ſeeke alwaies to confound the ſent; ſometimes by taking hedges, otherwhiles waters; ſometimes running among ſheepe and other beaſts of ſtronger ſent; ſome-

sometimes making doubles, and treading the same path over and over; and sometimes leaping with great jumpes hither and thither, before they betake themselves to their rest; that so the continuateness of the sent may not lead dogges to their forme.

40. Of foxes that catch hens by lying under their roost, and by gazing upon them.

Now to penetrate into the causes of these and of such like actions; we may remember, how we shewed in the last Chapter, that the beating of the heart worketh two things: the one is, that it turneth about the species, or little corporeities (streaming from outward objects) which remaine in the memory: the other is, that it is alwaies pressing on to some motion or other: out of which it hapneth, that when the ordinary waies of getting victuals, or of escaping from enemies doe faile a creature whose constitution is active; it lighteth sometimes (though peradventure very seldome) upon doing something, out of which the desired effect followeth; as it cannot choose but fall out now and then, although chance onely doe governe their actions: and when their action proveth successfull, it leaveth such an impression in the memory, that whensoever the like occasion occurreth, that animal will follow the same method; for the same species doe come together from the memory into the fantasie. But the many attempts that miscarry, and the ineffectuall motions which straights doe cast beasts upon, are never observed, nor are there any stories recorded of them: no more then in the Temple of Neptune, were kept upon the registers, the relations of those unfortunate wretches, who making vowes unto that God in their distresse, were nevertheless drowned.

Thus peradventure, when the fox seeth his labour in chacing the hens, to be to no purpose; and that by his pursute of them, he driveth them further out of his reach; he layeth himselfe downe to rest, with a watchfull eye, and perceiving those silly animals to grow bolder and bolder, by their not seeing him stir, he continueth his lying still, untill some one of them commeth within his reach, and then on a sudden, he springeth up and catcheth her: or peradventure some poultry might have strayed within his reach whiles he was asleepe, and have then wakened him with some noise they made: and so he hapned to seise upon one of them, without either designe or paines taking beforehand:

hand: by ſuch degrees he might chance to catch one the firſt time: and they being ſetled in his memory, together with the effect; it happened that another time when hunger preſſed him, and ſent up to his braine like ſpirits unto thoſe which aſcended thither whiles he lay watching the hens, theſe ſpirits brought the other from his memory into the fantaſie (in ſuch ſort as we have ſhewed in the laſt Chapter) and ſo drove him to the ſame courſe, untill by frequent repetitions, it became ordinary and familiar with him: and then they that looke onely upon the performance of the artifice, are apt to infer diſcourſe and a deſigne of reaſon, out of the orderly conduct of it.

But how can we conceive the fox hath judgement to know when the henne is come within his leape, and accordingly offereth not at her till then; unleſſe we reſort to ſome other principles, then what is yet declared? The anſwer unto this objection I thinke will not be hard to finde; for if the motion, which the preſence of the object maketh in the heart, be proportioned out by nature (as there is no doubt but it is) it will not be ſo great and powerfull, as to make the fox leape at it, untill it be arrived ſo neere him, that by his nimbleneſſe he can reach it; and ſo without any ayme, further then by the meere fluxe of his paſſion conveniently raiſed, he doth the feate: but if his paſſion be too violent, it maketh him miſſe his ayme; as we may frequently obſerve both in men and beaſts: and particularly, when feare preſſeth either of them to leape over a ditch, which being too broad, he lighteth in the middeſt of it.

The ſame watchfulneſſe and deſire to have the poulen, that ſit upon a tree out of his reach, maketh him fix his eyes upon them, when they are at rooſte: and at length, either the brightneſſe and ſparkling of them, dazeleth the birds, and maketh them come downe to them, (as flyes do in the night about the flame of a candle; or as fiſhes doe to a light in a boates head;) or elſe they are affraid; and their feare increaſing, their ſpirits returne to the heart which thereby is oppreſſed, and their outward parts are bereaved of ſtrength and motion; from whence it followeth neceſſarily, that their footing looſeth their hold faſt, and they tumble downe halfe dead with feare, which happeneth alſo frequently to catts, when they looke wiſtly upon little birds that ſit quietly. Or peradventure, their feare maketh them giddy;

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as when some man looking downe a precipice from a dangerous standing, he falleth by the turning of his braine, though nothing be behind him to thrust him forwards. Or it may be, some steame commeth from the Fox, which draweth such creatures to him; as it is reported that a great and very poysonous Toade will do a Weasell, who will run about the Toade a great while, and still make his circle lesser and lesser, till at length he perisheth in the center, where his foe sitteth still, and draweth him to him: which he doth in such sort, as animated Mercury will draw leafe-gold duly prepared, or as the loadstone attracteth Iron: and yet it is apparent, the Weasell commeth not with his good will; but that there are some powerfull chaines, steaming from the body of the Toad, which pluck him hither against his liking; for by his motions and running, he wil expresse the greatest feare that can be.

5. From whence proceedeth the Foxes invention to ridde himselfe of Fleas.

The method which Foxes do practise, to ridde themselves of their fleas (if it be true) is obvious enough for them to fall upon; for in summer, their fleas together with their thick furred coate, cannot choose but cause an exceeding great itching and heate in their bodies; which will readily invite them to goe into the water to coole themselves; as the Merchants at the Isles of Zante and of Cephalonia told me (when I was there) it was the custome of our English Doggs (who were habituated unto a colder clime) to runne into the Sea in the heate of Summer, and lie there most part of the day, with onely their noses out of the water, that they might draw breath, and would sleep there with their heads layed upon some stone, which raysed them up, whiles their bodies were covered with the Sea: and those Dogs which did not thus, would in one summer usually be killed with heate and Fleas.

Now when the Fox feeleth the ease that the coolenesse of the water affordeth that part of him which sitteth in it, he goeth further and further; yet would not put himselfe to swim, which is a labour, and would heate him, and therefore he avoideth it; so that whiles he thus cooleth himselfe in some shady place (for it is naturall unto him, in such an occasion, to resort unto the coole shade, rather then to lie in the Sunne) and in such there being for the most part some boughes hanging over the water, it happeneth naturally enough, that he taketh

some of the lowest in his mouth, to support him, and save him the labour of swimming, whiles he lyeth at his ease, soaking and cooling himselfe in the River. By which meanes it commeth to passe, that the Fleas finding no part of him free from water, do creepe up to the bough to rescue themselves from drowning: and so, when he is cooled enough, he goeth away and leaveth them there. In all which finding a benefit and satisfaction, whensoever the like occasion bringeth those species, from his memory into his fantasy, he betaketh himselfe to the same course, and therein finding his remedy, at length it groweth familiar to him.

In the like manner, Thales his Mule, that was heavily loaden with Salt, happening to stumble, and to fall in a River she was going over, the Salt melted by the water soaking into the sacks, and so she was eased of her burden; which successe made her, whensoever she came to a river, and was troubled with her loading, shee would lie downe in the water; and could not be reclaymed from it, till they charged sacks of wooll upon her backe, which growing heavier by their imbibing of water, weaned her from her former crafty habit. By which it is apparent, that it was memory and not judgement, which made her for a while behave her selfe so subtilly.

6. An explication of two other inventions of Foxes.

For the Foxes driving the Badger from his earth, you will not thinke it needfull to allow him a forecast and designe in pissing in it: but as it is naturall for him, to rest in a place that he meeteth with fit for that purpose; so it is for him to pisse in it, if the list take him whiles he is there; which in all likelyhood it will, if he stay any time there, and give a relaxation to all his parts by sleep.

And when he pisseth in his taile, and shaketh it in the Dogs eyes, it is evident that feare, not craft causeth this effect; for it availeth him little, and therefore is not likely to proceed from judgement. And of the other, it is a naturall effect in all beasts (when it is violent) to contract their tailes betweene their legs, and to make their urine come from them, (by compressing the spirits in their heart, which should support their outward parts, and strengthen their splincter muscle) which their being snapped at and seised upon by the Dogs, shaketh from their bushy tailes (fit to retaine it) and then lighting in the Dogs eyes, the

the acrimony of it hurteth them, and maketh them shut their liddes.

The story (if it be true) of the Fox, that to save himselfe from the Dogs that he heard following him in full cry, did hang by his teeth among dead vermine in a warren, is a very strange one I confesse: but it is conceivable, how feare and wearinesse might cause him to seeke a shelter to hide himselfe: and in so plaine a tract of ground as warrens use to be in, without any bush or hill to have recourse unto for relieſe, there appearing nothing but a gallowes hanging full of vermine; his fantasy might be moved (he being able to run no further) to thrust himselfe among those dead bodies, that he saw rested quietly: and having no way to mingle himselfe with them, but hanging by his teeth; he might continue in that posture, till the Dogs not suspecting him in the ayre, might run under him, and overshoot the sent: which whiles they cast about to recover, by running to beate the next wood or shelter in view (as is their custome in losses of their chance; unto which they are brought by their masters hunting them in that method at the first) the wily animall stealeth an other way, and recovereth himself.

7. Concerning Mountagues argument to prove that Dogs make syllogismes.

This overrunning of the sent by Dogs in the earnestnesse of their chace, putteth me in mind of Montagues argument, out of which he will infer, that Dogs use discourse, and do make syllogismes in their hunting: for (saith he) when they have followed their chace downe a Lane, that at length divideth it selfe into three others; they will carefully smell at the first and at the second, and not finding that it hath gone in either of those, they boldly runne upon the third, without ever laying their Noses to the ground; as being assured by their discourse and reason, that since it went not in the two first, and there being but one remaining, it must of necessity have gone there.

But this needeth no other cause, then that their eagernesse of hunting having made them overshoote the sent, (which for a while remaineth in their noses, after they are parted from the object that caused it) they cast back againe (as they are accustomed to be made to do in like occasions by the hunters that train them up) and with their noses they try the ground all the way they goe; till comming neere where the chace went indeed, the

sent striketh their Noses ( that by this time are growne empty of it ) before they come at the place : and then they run amaine in pursuit of it, with their heads held up, ( which is their convenientest posture for running) and all the way, the sent filleth them at that distance without their needing to smell upon the Earth, to fetch it from thence.

8. A declaration how some tricks are performed by Foxes, which seeme to argue discourse.

That Fox which used to cast himselfe by the advantage of a bough into his Denne, was so closely pursued by the Dogs the first time hee ventured upon this feate, that he had not time to goe into his Earth ( his ordinary retreate, when hee is neerer it ) by the easy and accessible way ; but on the on side, to get thither being strong in his fantasy, and on the other side, the precipice which he had often seene, comming likewise thither from his memory ; these two concurring could not choose but make him goe warily thither : and in so dangerous a leape, it is naturall for him, to helpe himselfe by any thing in the way that can advantage him : which happening to bee by catching in his mouth a bough that hung over his Den, ( the onely suddaine meanes hee had to take hold of any thing ) and from thence taking as it were a new rise for a second leape, he findeth himselfe in security : whiles the Dogs unacquainted with the place, runne violently on, as in the rest of their chace : and so are upon the brim of the precipice, before they perceive it ; and then it is too late for them to stop their course, and consequently, they break their necks. Which mischiefe to them the Fox needeth not have in his designe, and accordingly tolle them that way ; but chance begetting this deliverance of him at the first, when he was so hard pressed, his memory teacheth him to follow the same course, whensoever the like occasion occurreth.

But how many Foxes do there perish in attempts, which if they succeeded, would have beene accounted by slight judgers to be notable subtilities ; but miscarrying are esteemed tumultuary motions without designe, caused by that animalls fantasy and spirits, when he is in extremity ? I remember how upon a time, when I was hunting one, hee being hard set, and but a little before the Dogs and the Hunters, caught in his mouth the bough of a crooked Ash-tree he runne up a prety way ; which being in a hedge, he thereby hung down along the side of the

the hedge, and when we struck him over the ribs with our poles, he would not quit his hold, ( so strongly the feare of the dogs wrought in his fantasy ) till greater blowes knocked him on the head. Which sheweth evidently that this action, was the effect of chance pressing his fantasy to do something ; and not any reason or discourse providing for his safety : as we have already said upon occasion of the others hanging among the dead vermine in the warren.

Those in Thracia, that will not goe over a frozen River, when the yce is too thin to beare them, are by their memory, not by their judgement taught to retire; for at other times they have been wetted, when they have heard the noise of the streame running under the yce : or the very running of the water calleth the species of swimming out from their memory, along with it into their fantasy (neither of which is pleasant to them in the winter ) and so disliking the noise for the other effects sake, that used to accompany it, they avoyde that which begetteth it, and so retire from the river. And the reason of their listening to the noise, proceedeth from the spirits, that their passion upon apprehension of a danger presseth into the nerves of their senses, as well as into the other nerves of their braines ; which accordingly maketh them so vigilant and attentive then to outward objects and motions.

9. Of the Jaccatrays invention in calling beasts to himselfe.

That the Jaccatray or Hyæna, when he is hungry, should have his fantasy call out from his memory, the Images of those Beasts, which use to serve him in that occasion, is the ordinary course of nature : and that together with those images, there should likewise come along the actions and sounds which used to accompany them, and are lodged together with them in the memory, is also naturall ; then, as little strange it is, that by his owne voyce he should imitate those sounds, which at that time do so powerfully possesse his imagination : and having a great docility in those Organs which forme the voice, like a Parrat he representeth them so lively, that the deceived beasts flock to him, and so are caught by him : which at the first happeneth by chance, but afterwards by memory, and groweth familiar to him.

11. Of the Jaccals designe in serving the Lion.

Nor can we imagine, that the Jaccall hath a designe of serving the Lyon ; but his nature being (like a dog) to bark when he

he feeleth the sent hot (which he pursueth for his owne sake) the Lyon that dwelleth in the same woods with him, meeteth with the noise, and followeth it; and peradventure would kill the Jaccall himselfe, as well as what he hunteth, if he could overtake him: but he being too nimble for the Lyon, keepeth out of his reach; till having wearied the beast he chaceth the Lyon that followeth by the cry, commeth in when he is at abay, and soone teareth in pieces what the other had not strength enough so suddainly to master, and feedeth himselfe upon the Quarry till he be full. All this while the Jaccall dareth not come neere the Lyon, but standeth at a distance with feare wayting till he have done, and then after he is gone away, hee taketh his turne to feede upon what his surly master hath left.

11. Of severall inventions of Fishes.

The like reason it is probable we might find out among those Fishes that serve one an other, if we had the conveniency of observing particularly how they behave themselves; as when the Whale hath service from his little guide (if the report be true; which is a necessary circumstance to be inserted in every such ta'e) and others of the like staine.

The suttlety of the Torpedo (who hideth himselfe in the mud to benum Fishes, that may afterwards serve him to feed upon) will not require to have its origine from reason, and be done by designe; when you shall consider it is naturall for such cold Creatures to immud themselves: and then the Fishes that swim within the reach of his benumming faculty, will be stayd and frozen there: which because they see him not, they apprehend not, till it be too late for them to avoid it: and then, when the Torpedo commeth out, he feedeth upon what he findeth lying ready in his way.

And in like manner, the Scuttle-fish, when he is in straights of being taken by the Fisherman, casteth out a blackenesse that is within him, and so making the water become like Inke, he oftentimes escapeth their hands in the darkened Element: which ariseth from no discourse of his, but feare maketh him voyd this liquor that is in him (as it made the Fox voyd his Urine) and in consequence thereunto, the effect followeth.

12. A discovery of divers things done by hares, which seeme to argue discourse.

Lastly, when Hares do use those meanes we have mentioned to confound the sent, and to save themselves from the dogs

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that hunt them, we may obſerve, that they take therein the readieſt wayes, and the moſt obvious unto ſenſe, to avoid the evill they flie from. For what can be more direct to that effect, then to hide themſelves in hedge-bottomes, or in woods? Or to ſwim over a River, when that is the moſt immediate way to runne from the dogges? And when they are in a plaine, where there is no other ſhelter but flocks of ſheepe or heards of deere, what can be more naturall, then for them to hide themſelves among them, and run along with them, till the cry of the approaching hounds fright them away, whiles thoſe tamer beaſts abide it neerer?

Their doublings backward and forward, may proceed from their feare, that diverteth them ſtill from the way they are in at preſent, till the dogs comming neer, do put the hare out of thoſe wauerings, and do make her run ſtraight away: for they never double but when they are a great way before the dogs, and do not heare them. Or elſe it may be, that not hearing or ſeeing the dogs, their feare may be almoſt paſſed; and then the agitation which their ſpirits are in, governeth the motions of their body, and will not let them reſt untill they be more appeaſed, (as you ſee weary people, that at their firſt ceaſing from running, cannot ſit ſtill: the like of which happeneth alſo frequently in the motions of joy or of anger) and ſo it maketh them walke backwards and forwards, in a pace proportionate to the agitation of the ſpirits within: and ſometimes thoſe moved ſpirits doe make them bound and leape to and fro (like the loafe with quickeſilver, we have heretofore ſpoken of) as they iſſue from the heart by pulſes and ſtroakes; which happeneth when they begin to ſettle towards reſt. Or elſe peradventure their forme is ſo framed, that if they ſhould get into it otherwiſe then by a jumpe, they would diſorder ſome part of it, and ſo be unfenced and acold, or otherwiſe at uneaſe during their repoſe: and therefore their jumping to and fro, before they leap plump in, is to take their aime; not much unlike to dogs, turning about ſeverall times before they lie downe: for hare-finders (who uſe to watch them) ſay they will do thus, though they be not purſued. And thus theſe actions which are imputed to craft, thereby to confound the dogs, or to wiſedom, to walke themſelves untill they be growne into a

fitting temper to fit ſtill; may all of them be reduced to thoſe materiall and corporeall cauſes, which make them do their other ordinary motions, wherein we find no difficulty.

13. Of a Fox reported to have weighed a Gooſe, before he would venture with it ouer a River; and of fabulous ſtories in common.

If that of the Foxes weighing his Gooſe, before he would venture to carry it over the river, were plainly true, as it is ſet down; I avow I ſhould be hard ſet to find the principles from whence that diſcretion in him proceeded: but I conceive this tale may be paired with that, which telleth us of an other Fox who having his prey taken from him by an Eagle, brought the next day a new prize in the ſame place, having firſt rolled it in the fire, ſo that ſome burning coales ſtuck upon it; which the Eagle comming againe and ſnatching from him, carried to her Neſt, which was thereby ſet on fire; and the young ones falling down, became the Foxes ſhare, inſteed of what their damme had robbed him of. Such ſtories ſo quaintly contrived, are fitter for a morall then for a naturall Philoſopher: Æſope may entertaine himſelfe and his Diſciples with them; whiles all the reflection I ſhall make upon them, is, that when I heare any ſuch finely ordered Tales, I cannot doubt but they are well amended in the relation, by thoſe that tell them: it being the inclination and cuſtome of moſt men, (partly through a deſire of having ſtrange things come from them; and partly out of a care that what they ſay may appeare like truth, and ſo be the eaſier believed) to add circumſtances beyond the truth of the matter: which increaſing at every new mans relation of the ſame accident (for this humour raigneth very generally) at the length, ſo handſome, and yet ſo ſtrange a Tale is compoſed, that the firſt author or teller of it, wonderеth at it as well as others, and cannot diſcerne that his ſtory begot this latter.

Therefore, when one of theſe fine tales is propoſed to ſpeculate upon, and that I have no light to guide me in determining what part of them to allow, and what to reject; I thinke it better to expect an authenticke record of it, then be too hafty at gueſſes: leaving ſuch as pretend ability in reading of Riddles, to deſcant of the wayes how ſuch actions may be effected: but for others, that have a ſemblance of truth, or do happen ordinarily, be they at the firſt ſight never ſo like the operations of reaſon, I doubt not but that the cauſes of them may be reduced to

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the principles we have already eſtabliſhed; and the waies of performing them may be pitched upon by ſuch diſcourſes about them, as we have made about thoſe examples we have above produced. Eſpecially if the actions themſelves were obſerved by one that could judge of them, and were reported with a deſire of expreſſing the truth nakedly as in it ſelfe it lieth; for divers times it hapneth, that men ſaying nothing but truth, do expreſſe it in ſuch a manner, and with ſuch terms, that the ignorant hearer conceiveth the thing quite another way, then indeed it is, meerly for the too emphaticall expreſsions: eſpecially if the relatour himſelfe miſſeth in conceiving the true cauſes of what he reporteth, and ſo expreſſeth it proportionable to thoſe which he apprehendeth.

To conclude then this firſt branch, we ſee how the doubting, the reſolving, the ayming, the inventing, and the like, which we experience in beaſts, may by the veſtigiaes we have traced out, be followed unto their root, as far as the diviſion of rarity and denſity; without needing to repaire unto any higher principle, ſaving the wiſdome of the orderer and Architect of nature, in ſo admirably diſpoſing and mingling theſe materiall, groſſe, and lifeleſſe bodies, that ſtrange effects and incomprehenſible unto them, who will not looke into their ſeverall joynts, may follow out of them, for the good of the creature in whoſe behalfe they are ſo ordered.

14. Of the ſeverall cryings and tones of beaſts: with a refutation of thoſe authors who maintain them to hive compleat languages.

But before we go to the next point, we cannot forbeare mentioning their vanity as well as ignorance, who to purchaſe the eſtimation of deeper knowers of nature, would have it believed, that beaſts have compleat languages, as men have, to diſcourſe with one another in; which they vanted they had the intelligence of. It is true, that in us ſpeaking or talking is an operation of reaſon; not becauſe it is in reaſon; but becauſe it is the worke of reaſon, by another inſtrument; and is nowhere to be found without reaſon: which thoſe irrationall Philoſophers, that pretended to underſtand the language of beaſts, allowed them, as well as the ability of talking to one another: but it was becauſe they had more pride then knowledge. Of which ranke one of the chief was Apollonius, ſurnamed from Thyana; for if he had knowne how to looke into the nature of beaſts, he would have perceived the reaſon of the divers voyces which the ſame beaſt in divers occaſions formeth.

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This is evident, that an animals lungs and cheſt, lying ſo neere as they doe unto his heart; and all voyce being made by the breathes comming out of his mouth, and through his windpipe; it muſt neceſſarily follow, that by the divers ordering of theſe inſtruments, his voyce will become divers; and theſe inſtruments will be diverſly ordered in him, according to the divers motions of his heart: that is, by divers paſſions in him (for ſo we may obſerve in our ſelves, that our breath is much changed by our being in paſſion;) and conſequently, as a beaſt is agitated by various paſſions, he muſt needs utter variety of voyces, which cannot chooſe, but make divers impreſſions in other beaſts that have commerce with him, whether theybe of the ſame kind as he is, or of a different: and ſo we ſee, that if a dog ſetteth upon a hog, the bitten hogs cry maketh an impreſſion in the other hogs, to come to their fellows reſcue, and in other dogs to runne after the crying hog: in like manner, anger in a dog maketh ſnarling or barking, paine, whining; deſire, another kind of barking; and his joy of ſeeing a perſon that he uſeth to receive good by, will breake out in another kind of whining. So in a henne, her divers paſions worke divers kinds of clocking; as when ſhe ſeeth a kite, ſhe hath one voyce, when ſhe meeteth with meate another; when ſhe deſireth to gather her chickens under her wings, a third: and ſo, upon divers occaſions, a divers ſound; according to the divers ordering of her vocall inſtruments by the paſſion which preſſeth her heart. So that who would looke curiouſly into the motions of the diſpoſitions of a beaſts vocall inſtruments, and into the motions of the ſpirits about his heart (which motion we have ſhewed is paſſion) would be able to give account, why every voyce of that beaſt was ſuch a one, and what motion about the heart it were that cauſed it.

And as much may be obſerved in men, who in paines and griefes, and other paſſions, doe uſe to breake out into thoſe voyces, which we call interjections; and which ſignifie nothing in the underſtanding of them that forme them, but to the hearer are ſigns of the paſſion from whence they proceed: which if a man doe heedfully marke in himſelfe, he will perceive, that they are nothing elſe, but the ſudden eruptions of a great deale of breath together, cauſed by ſome compreſſion made within him, by the

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paine he is in. Which is the reaſon that the ſtriving againſt groanings in certaine occaſions, doth ſicke perſons much harm; for it diſordereth the naturall motions of ſome principall parts within him, that are already too much agitated; and the counter-motion by which they are checked, putteth them further into a more violent agitation. In the obſervation of theſe naturall eruptions of mens breath, cauſed by paſſion, our forefathers of old were ſo induſtrious, as to transferre the imitation of nature in this particular into Muſicke, ſo that their kinds of Muſicke were diſtinguiſhed according to the diviſion of mens paſſions; and by ſimilitude would raiſe them in the hearers.

Out of this diſcourſe alſo reaſon may be given, why birds are more muſicall then other creatures, to wit, becauſe they are of a hotter complexion; and therefore, to their bigneſſe, doe require more breath and ayre to coole them; and conſequently doe make more noiſe, and more variety of it. Likewiſe among beaſts dogs are the moſt vocal of any that converſe with us; who by their ready anger appeare to be the hotteſt. Among men, thoſe that are merry, or ſoone become heated with a little wine, are given to talking or ſinging: and ſo are children, and women likewiſe; not ſo much through aboundance of heate, as becauſe their heat doth eaſily vent.

And thus it is evident, that there is no true language among beaſts: their voices not being tokens of divers things or conceptions, but meerely the effects of divers breathings, cauſed by divers paſſions. Wherefore, ſince both breathing and paſſion, are eaſily reduced to the common principles of rarity and denſity; we need not trouble our ſelves any further, to ſeeke into the origine of this vocall faculty of beaſts.

## THE SEVEN AND THIRTIETH CHAPTER,

*Of the docility of some irrationall animals; and of certaine continuate actions of a long tract of time so orderly performed by them, that they seeme to argue knowledge in them.*

1. How hawkes and other creatures are taught to do what they are brought up to.

AS for docility, (which is our second head) Apes and Elephants are most famed. Though peradventure, the cunning and obedience of our hawkes and dogs, is no whit inferiour to what is reported of them; and would be as much admired, were it not so common. I have by sundry persons who have seen him, been told of a baboone, that would play certaine lessons upon a guittare. The Indian histories make mention of Apes, that will goe to the Taverne and fetch Wine for their masters; as Lipsius his dog would bring his master as much meat from the market, as he carried money to his butcher to pay for. Of Elephants likewise, strange things are told: but because we cannot easily judge how to understand reports, whereof we have not seen the experience, nor how farre to believe them, I intend not to insist upon the examining of them; for by looking into the nature and art of our hounds that follow a suite of blood, or that draw dry foot; and of our hawkes, especially of the decoy ducks and cormorants; a scantling may be given at all the rest. And although these things told at randome, may justly seeme very admirable to any man the first time he heareth of them, yet to him that understandeth how they are taught, there is no one passage but will appeare plaine enough.

The first degree is to tame the hawke by watching her from sleepe, and to acquaint her with the man, by continually carrying her upon his fist, and using her to take her meat quietly, as she sitteth upon his hand. Then he maketh her hop a little way to it in a paire of cranes: and after a while, kill a seeled pigeon; from which he taketh her when she is growne steady in her lesson so farre, and feedeth her up with other meate: and thus in time he bringeth her to flie at what he will have her, and to be content with

with a small reward, leaving her quarry to her master; so that a spectatour, who understandeth not the mystery, nor ever saw hawking before, may well admire to see a bird so dutifully and exactly obey a mans command: and may conceive she hath a reasonable soule, whereby to understand him, and discourse of the meanes to bring his purpose to effect. Whereas indeed, all this is no more, then to make her doe for you and when you please, the same which she doth by nature to feed her selfe.

The cunning of dogs is begotten in the same way. Coyducks are beaten and whipped to what they are taught, like setting dogs. Cormorants have their throats tied, that they may not swallow the fish they catch, but be constrained to bring it to the man that imployeth them; so that looking along step by step, you shall meet with nothing but what is plaine and easie to be taught, and to be performed by sense and memory; without needing to attribute any discourse or reasoning unto beasts.

Apes are likewise taught as dogs may be, to carry things to a certaine house; where receiving what is given them, they returne home with it: and you may be confident, this serviceablenesse of the Ape, grew out of his being carried first to the taverne by the mayd or boy, who there gave him somewhat that pleased him; and then being made to carry the pot along by the boy; and afterwards being made to carry money in one hand, and the pot in the other; whereof some drawer discharged him of the one, and filled the other, and withall gave him a reward; which also was repeated to him at his returne home with his full pot: till at the last, when he was sufficiently used to this exercise, he would of himselfe goe straight thither, as soon as he was harnessed in such sort as he used to be for this service. Which appeareth to be assuefaction and custome, not judgement, by his receiving indifferently whatsoever is put into his pot.

And by the tale of Lipsius his dog; from whom other lesse dogs, snatching as he trotted along, part of what hung out of his basket (which he carried in his mouth) he set it downe to werry one of them; whiles in the meane time, the others fed at liberty and at ease upon the meate that lay there unguarded; til he comming backe to it, drove them away, and himselfe made an end

of

of eating it up. Whereby we may conceive that the ſpecies of carrying his basket to his maſter (which cuſtome had ſetled in his memory) was diſordered, and thruſt out of his fantaſie, by a ſtronger, of fighting for his meat with the other curres: after which it followed naturally in his fantaſie, to eate what he had fought for. And that ſending then ſpirits into his nerves, agreeable to the nature of it, and governing the parts depending of the braine, a motion and action enſued, which was ſutable to the object in the fantaſie; and this could be none other, but of eating what the fantaſie found conformable unto its nature.

2. Of the Baboon that played on a guitarre.

The baboone we have mentioned, might be taught ſome leſſons made on purpoſe with very few ſtops, and upon an inſtrument whereon all the ſtrings may be ſtrucken with one blow, and but one fret to be uſed at a time, and that fret to be ſtopped with one finger: of which much labour and time might beget a habit in him: and then, imitation of the ſound, might make him play in due meaſure. And if we will marke it in our ſelves, we ſhall ſee, that although in the firſt learning of a leſſon upon the Lute, we imploy our reaſon and diſcourſe about it; yet when we have it very perfect, our fingers (guided by a ſlight fantaſie) doe fall by cuſtome, without any reflexion at all, to play it as well as if we thought never ſo carefully upon it. And there is no compariſon, betweene the difficulty of a guittarre and of a lute.

I have been told that at the Duke of Florence his marriage, there was a dance of horſes, in which they kept exact time of muſicke. The meanes uſed for bringing them to it, is ſaid to have been by tying and hampering their legs in ſuch a ſort, that they could lift them up but in a determinate way: and then ſetting them upon a pavement, that was heated underneath ſo hot that they could not endure to ſtand ſtill, whiles ſuch muſicall ayres were played to them, as fitted their motions. All which being often repeated, the horſes tooke a habit, that in hearing thoſe ayres, they would lift up their legs in that faſhion; and ſo danced to the tune they had been taught.

3. Of the teaching of Elephants and other beaſts to doe divers tricks.

Of the Elephants, it is ſaid that they may be taught to write; and that purely upon words and commanding them; they will doe what they are bidden; and that they are able to keepe account,

count, and will leave working at a precise number of revolutions of the same action, which measureth out their taske unto them. All which (as I said before) if it were plainely and literally true, would require very great consideration: but because the teachers of beasts have certaine secrets in their art, which standers by doe not reach unto; we are not able (upon such scanty relations as we have of them) to make sufficient judgement how such things are done; unlesse wee had the managing of those creatures, whereby to try them in severall occasions, and to observe what cause produceth every operation they doe; and by what steps they attaine unto their instructions and serviceableneese.

It is true, the uncontrolled reports of them, obliege us to beleeve some extraordinary matter of their docility, and of strange things done by them: but withall, the example of other taught beasts among us, and of the strange judgements that are made of them by persons, who doe not penetrate into their causes, may instruct us how easie it is to mistake the matter; and assure us, that the relations which are made us, doe not alwaies punctually agree with the truth of what passed. He that should tell an Indian what feats Bankes his horse would doe; how he would restore a glove to the due owner, after his master had whispered that mans name in his eare; how he would tell the just number of pence in any piece of silver coyne barely shewed him by his master; and even obey presently his command, in discharging himselfe of his excrements whensoever he bade him (so great a power art may have over nature:) would make him believe admire more at this learned beast, then we doe at their docile Elephants, upon the relations we have of them. Whereas every one of us knoweth, by what meanes his painefull tutor brought him to doe all his tricks: and they are no whit more extraordinary, then a fawkners manning of a hawke, and training her to kill partriges, and to flie at the retrive: but doe all of them (both these, and all other jugling artificies of beasts) depend upon the same, or like principles; and are knowne to be but directions of nature, ordered by one that composeth and levelleth her operations to another end further off (in those actions) then she of her selfe would aime at. The particulars of which, we need not trouble our selves to meddle with.

But

4. Of the orderly traine of actions performed by beasts in breeding their yong ones.

But it is time that we come to the third sort of actions performed by beasts, which we promised to discourse of. These seem to be more admirable, then any we have yet touched: and are chiefely concerning the breeding of their yong ones. Above all others, the orderly course of birds in this affaire, is most remarkable. After they have coupled they make their nest, they line it with mosse, straw and feathers; they lay their egges, they sit upon them, they hatch them, they feed their yong ones, and they teach them to flie: all which they doe with so continuate and regular a method, as no man can direct or imagine a better.

But as for the regularity, orderlinesse, and continuance of these actions, the matter is easie enough to be conceived: for seeing that the operation of the male, maketh a change in the female; and that this change beginning from the very first, groweth by time into divers proportions: it is no wonder that it breedeth divers dispositions in the female, which cause her to doe different actions, correspondent to those divers dispositions. Now, those actions must of necessity be constant and orderly, because the causes whence they proceed, are such.

But to determine in particular how it commeth to passe, that every change in the female, disposeth her to such and such actions, there is the difficulty; and it is no small one: as well, for that there are no carefull and due observations, made of the effects and circumstances which should guide us to judge of their causes; as because these actions are the most refined ones of sensitive creatures; and doe flow from the top and perfection of their nature; and are the last straine of their utmost vigour, unto which all others are subordinate. As in our enquiry into the motions and operations of the bodies of a lower orbe then these, we meet with some (namely the loadstone, and such like) of which it is very hard to give exact and plaine account; the Author of them reserving something from our cleare and distinct knowledge; and suffering us to looke upon it but through a miste: in like manner we cannot but expect, that in the depth of this other perfecter nature, there must be somewhat whereof we can have but a glimmering and imperfect notion. But as in the other, it served our turne to trace out a way, how those operations might be effected by bodies, and by locall motion

motion (though peradventure, we did not in every circumstance hit exactly upon the right) thereby to defend our selves from admitting those chymericall qualities, which we had already condemned upon all other occasions.

So I conceive, it will be sufficient for us in this, to shew how these actions may be done by the senses, and by the motion of corporeall spirits, and by materiall impressions upon them; without being constrained to resort unto an immateriall principle, which must furnish birds with reason and discourse: in which, it is not necessary for my purpose, to determine precisely every step by which these actions are performed, and to settle the rigorous truth of them: but leaving that unto those, who shall take pains to deliver the history of their nature, I will content my selfe with the possibility and probability of my conjectures. The first of which qualities, I am obliged to make plain; but the latter concerneth this Treatise no more, then it would do a man to enquire anxiously into the particulars of what it is that a beast is doing, whiles looking upon it at a great distance, he perceiveth plainly that it moveth it selfe: and his arrant is, but to be assured whether it be alive or dead: which the moving of it selfe in common, doth sufficiently demonstrate, without descending into a particular search, of what his motions are.

But let us come to the matter: first I conceive no man will make any difficulty in allowing, that it is the temper of the blood and spirits in birds (brought thereunto by the quality of their food and by the season of the yeere) which maketh them couple with one another; and not any ayme or desire of having young ones, that occasioneth this action in them. Then it followeth that the hens egges will encrease in her belly; and when they grow big, they cannot choose but be troublesome unto her; and therefore must of necessity breed in her an inclination to rest in some soft place, and to be rid of them. And as we see a dog or a cat pressed by nature, searcheth about to finde a convenient place to disburden themselves in, not onely of their young ones, but even of their excrements; so do birds, whose egges within them, making them heavy and unfit to flie, they begin to sit much and are pleased in a soft and warme place: and thereupon they are delighted with straws and mosse, and other gentle sub-

ſtances; and ſo carry them to their fitting place: which that they do not by deſigne, is evident by the manner of it; for when they have met with a ſtraw or other fit materiall, they flie not with it directly to their neſt, but firſt to a bough of ſome tree, or to the top of a houſe; and there they hop and dance a while with it in their beakes; and from thence skip to another place, where they entertaine themſelves in like manner: and at the laſt, they get to their neſt: where if the ſtraw ſhould lie confuſedly, their ends would pricke and hurt them: and therefore they turn and alter their poſitions till they lie ſmooth: which we that looke upon the effect, and compare them with our performing of like actions (if we had occaſion) may call a judicious ordering of them, whereas in them, it is nothing but removing ſuch things as preſſe upon their ſenſe, untill they cauſe them no more paine or unquietneſſe.

Their plaſtering of their neſts, may be attributed to the great heat raigning in them at that time; which maketh them ſtill be dabbling in moiſt clay, and in water, and in gravell, (without which, all birds will ſoon grow ſicke, blind, and at length die) which (for the coolneſſe of it) they bring home to their neſts in their beakes and upon their feet; and when it groweth dry, and conſequently troubleſome to them, they wipe it off, and rubbe their dirty parts upon the place where they uſe to ſit; and then flie for more to refreſh themſelves withall.

Out of all which actions (ſet on foot by the wiſe orderer of nature, to compaſſe a remote end, quite different from the immediate end that every one of them is done for) there reſulteth a fit and convenient place for theſe little builders (that know not what they doe, whiles they build themſelves houſes) to lie in, and to lay their egges in. Which the next yeere, when the like occaſion occurreth, they build againe; peradventure then, as much through memory of the former, as upon their temper and other circumſtances, moving their fantaſie, in ſuch ſort as we have ſet downe.

In like manner, that whiles the Halcyon layeth and hatcheth her egges, the ſea is calme, needeth no more be attributed to the wiſdome and providence of that bird, in chooſing a fit ſeaſon, then to any good nature or diſcourſe in that rouling and mercileſſe

leſſe Element; as though it had a pious care of preſerving the egges committed to his truſt: no ſuch ſupplements are requiſite to be added unto the diſtributions of nature, who hath ſet material cauſes on foot, to produce a conjuncture of both thoſe effects at the ſame period of time, for the propagation of this animals ſpecies.

In fine, both the time and the place of the Halcyons breeding, and the manner, and order, and reaſon of all birds making their neſts, proceedeth from ſecret motions, which doe require great obſerving and attention to underſtand them; and doe ſerve for directions unto every bird, according to her kind, to make her neſt fitteſt for her uſe. Which ſecret motions, we cannot doubt but are materiall ones, and doe ariſe out of the conſtitution and temper of their bodies and ſpirits; which in like circumſtances are alike in them all: for all the birds of one kind, do make their neſts exactly alike; which they would not doe, if this worke proceeded from reaſon in them, and were governed by their owne election and deſigne: as we ſee it happen among men upon all occaſions, either of building houſes, or of making clothes, or of what action ſoever is guided by their reaſon governing their fantaſie; in all which we ſee ſo great variety and inconſtancy.

And therefore this invariability in the birds operations, muſt proceed from a higher intellect, that hath determinately and preciſely ordered a complexe or aſſembly of ſundry cauſes, to meet infallibly and by neceſſity, for the production of an effect that he hath deſigned: and ſo, the birds are but materiall inſtruments to performe without their knowledge or reflexion, a ſuperiour reaſons counſels: even as in a clocke, that is compoſed of ſeverall pieces and wheeles, all the parts of it doe conſpire to give notice of the ſeverall effluxes and periods of time, which the maker hath ordered it for.

And although this be a worke of reaſon and diſcourſe in him, that did ſet it together; yet the inſtrumentall performance of it dependeth meerely of locall motion, and of the revolutions of bodies, ſo orderly proportioned to one another, that their effects cannot faile, when once the engine is wound up: in like manner then, the bird is the engine of the Artificer, infinitely more perfect, and knowing, and dexterious then a poore clock-

maker; and the plummets which doe make it goe, are the row and order of cauſes chained together, which by the deſigne of the ſupreame workman, do bring to paſſe ſuch effects, as we ſee in the building of their neſts, and in doing ſuch other actions, as may be compared to the ſtrikings of the clocke, and the ringing of the alarme at due times.

And as that King of China, upon his firſt ſeeing a Watch, thought it a living and judicious creature, becauſe it moved ſo regularly of it ſelfe, and believed it to be dead when it was run out; till the opening of it and the winding it up, diſcovered unto him the artifice of it: ſo any man may be excuſed, that looking upon theſe ſtrange actions, and this admirable oeconomy of ſome living creatures ſhould believe them endewed with reaſon, untill he have well reflected upon every particular circumſtance of their nature and operations: for then he will diſcerne how theſe are but materiall inſtruments of a rationall agent working by them; from whoſe orderly preſcriptions, they have not power to ſwarve in the leaſt circumſtance that is. Every one of which conſidered ſingly by it ſelf, hath a face of no more difficulty, then that (for example) an engineer ſhould ſo order his matters, that a mine ſhould be ready to play exactly at ſuch an houre, by leaving ſuch a proportion of kindled match hanging out of one of the barrels of powder, whiles in the meane time, he either ſleepeth, or attendeth to ſomething elſe.

And when you have once gained thus much of your ſelfe, to gree unto an orderly courſe and generation of any ſingle effect, by the power of a materiall cauſe working it; raiſe but your diſcourſe a ſtraine higher, and looke with reverence and duty upon the immenſity of that provident Architect, out of whoſe hands theſe maſterpieces iſſue, and unto whom it is as eaſie to make a chaine of cauſes of a thouſand or of a million of links, as to make one linke alone: and then you will no longer ſticke at allowing the whole oeconomy of thoſe actions, to be nothing elſe, but a production of materiall effects, by a due ranging and ordering of materiall cauſes.

But let us returne to our theame: as we ſee that milke comming into the breaſts of live-bearing female creatures, when they grow very bigge, heateth and maketh them ſeeke the mouthes

mouthes of their young ones, to disburthen and coole them: so the carriage and bigneſſe of the egges, heateth exceedingly the breaſts and bodies of the birds; and this cauſeth them to be ſtill rubbing of their breaſts against the ſides of their neſts (whereunto their unwieldineſſe then confineth them very much) and with their beakes to be ſtill picking their feathers; which being then apt to fall off and mew (as we ſee the haire of women with childe, is apt to ſhed) it happeneth that by then they are ready to lay their egges, they have a ſoft bed of their owne feathers, made in their neſts, over their courſer mattraſſe of ſtrawes they firſt brought thither: and then, the egges powerfull attracting of the annoying heat from the hens breaſt (whoſe imbibing of the warmth, and ſtone-like ſhell, can not chooſe but coole her much) inviteth her to ſit conſtantly upon them, untill ſitting hatcheth them; and it is evident, that this ſitting muſt proceed from their temper at that time, or from ſome other immediate cauſe, which worketh that effect, and not from a judgement that doth it for a remote end: for houſewifes tell us, that at ſuch a ſeaſon, their hennes will be ſitting in every convenint place they come unto, as though they had eggs to hatch, when never a one is under them: ſo as it ſeemeth that at ſuch time, there is ſome inconvenience in their bodies, which by ſitting is eaſed.

When the chickens are hatched, what wonder is it, if the little crying of tender creatures, of a like nature and language with their dammes, do move thoſe affections or paſsions in her boſome, which cauſeth her to feed them, and to defend, and breed them, till they be able to ſhift for themſelves? For all this there needeth no diſcourſe or reaſon; but onely the motion of the blood about the heart (which we have determined to be paſsion) ſtirred by the young ones chirpings, in ſuch ſort, as may carry them unto thoſe actions which by nature (the ſupreme intellect) are ordered for their preſervation. Wherein the birds (as we have already ſaid) are but paſsive inſtruments, and know not why they doe thoſe actions: but doe them they muſt, whenſoever ſuch and ſuch objects (which infallibly work in their due times) doe make ſuch and ſuch impreſsions upon their fantaſies, like the allarum that neceſſarily ſtriketh, when

the hand of the diall commeth to such a point; or the gun-powder, that necessarily maketh a ruine and breach in the wall, when the burning of the match reacheth to it.

Now this love in the dam, growing by little and little wearisome and troublesome to her; and at last, fading quite away; and she not being able to supply their encreased needs, which they grow every day stronger to provide for of themselves; the strait commerce beginneth to dye on both sides: and by these degrees the damme leaveth her yong ones to their owne conduct.

And thus you see how this long *series* of actions, may have orderly causes, made and chained together, by him that knew what was fitting for the worke he went about. Of which, though it is likely I have missed of the right ones (as it can not choose but happen in all disquisitions, where one is the first to breake the yce, and is so slenderly informed of the particular circumstances of the matter in question, as I professe to be in this) yet I conceive this discourse doth plainly shew, that he who hath done more then we are able to comprehend and understand, may have set causes sufficient for all these effects, in a better order, and in compleater rankes, then those which we have here expressed: and yet in them so coursely hewed out, appeareth a possibility of having the worke done by corporeall agents. Surely it were very well worth the while, for some curious and judicious person, to observe carefully and often, the severall steps of nature in this progresse: for I am strongly perswaded, that by such industry, we might in time arrive to very particular knowledge of the immediate and precise causes, that worke all these effects. And I conceive, that such observation needeth not be very troublesome; as not requiring any great variety of creatures to institute it upon; for by marking carefully all that passeth among our homebred hens, I believe it were easie to guesse very neerely at all the rest.

THE

## THE EIGHT AND THIRTIETH CHAPTER.

*Of prescience of future events, providencies, the knowing of things never seene before; and such other actions, observed in some living creatures; which seem to be even above the reason that is in man himselfe.*

THe fourth and last kind of actions, which we may with astonishment observe among beasts, I conceive will availe little to infer out of them, that the creatures which doe them, are endewed with reason and understanding: for such they are, as if we should admit that, yet we should still be as far to seeke for the causes whence they proceed. What should move a lambe to tremble at the first sight of a woolfe? or a hen at a kite never before seene? neither the grimmest mastiffe, or the biggest owle, will at all affright them. 1. Why beasts are affraid of men.

That which in the ordinary course of nature, causeth beasts to be afraid of men, or of other beasts, is the hurt and the evill they receive from them: which comming into their fantasie, together with the Idea of him that did it, is also lodged together with it in the memory; from whence they come linked or glewed together, whensoever the stroake of any new object calleth either of them backe into the fantasie. This is confirmed by the tamenesse of the birds and beasts, which the first discoverers of Islands not inhabitated by men, did finde in those they met withall there. Their stories tell us, that at their first arrivall upon those coasts, where it seemeth men had never been, the birds would not flie away, but suffered the mariners to take them in their hands: nor the beasts, which with us are wild, would runne from them; but their discourteous guests used them so hardly, as they soone changed their confidence into distrust and aversion, and by little they grew, by their commerce with men, and by receiving injuries from them, to be as wilde, as any of the like kind in our parts.

From the dammes and fires, this apprehension and feare at

the ſight of men, ſo deeply rooted in them, is doubtleſſely tranſmitted to their young ones; for it proceedeth out of the diſpoſition of the body, and out of the paſsion which is immediatly made in the heart; and that is as truly a materiall motion, as any whatſoever can be; and muſt have ſetled materiall inſtruments fitted to it, if it be conſtant, as well as any other naturall operation whatſoever: and this paſsion of the heart, proceedeth againe from a perpetuall connexion of the two objects in the memory: which being a perpetually conſtant thing, is as true a quality of that beaſts braine in whom it is, as the being of a quicke or dull apprehenſion, or the being apt to know one kinde of meat from another (which is naturall to the whole ſpecies) or any other quality whatſoever, reſiding in that beaſt.

2. How ſome qualities cauſed at firſt by chance in beaſts, may paſſe by generation to the whole offſpring.

Wherefore it is no wonder, that it paſſeth by generation to the off-ſpring: which is a thing ſo common, even in mankinde, as there can be no doubt of it: and is at the firſt made by a violent cauſe, that greatly altereth the body: and conſequently their ſeed muſt be imbrewed with a like diſpoſition; and ſo it paſſeth together with the nature of the ſire, or of the dam, into the brood. From hence proceedeth, that children do love the ſame meates, and exerciſes, that their fathers and mothers were affected with, and feare the like harmes.

This is the reaſon, why a grand-childe of my Lord of *Dorſet* (whoſe honoured name muſt never be mentioned by me, without a particular reſpect, and humble acknowledgement of the noble and ſteady friendſhip, he hath ever been pleaſed to honor me with) was alwayes extremely ſick, if but the Nurſe did eate any Capers (againſt which my Lords antipathy is famous) whiles ſhee gave ſuck to that pretty infant. The Children of great Mathematicians, who have been uſed to buſie their fantaſies continually with figures and proportions, have been oftentimes obſerved, to have a naturall bent unto thoſe Sciences. And we may note, that even in particular geſtures, and in little ſingularities in familiar converſation, children will oftentimes reſemble their parents, as well as in the lineaments of their faces. The young ones of excellent ſetting dogges, will have a notable aptitude to that exerciſe; and may bee taught with halfe

halfe the paines, that their ſire or dam was, if they were choſen out of a race of ſpaniels not trained to ſetting. All which effects can proceed from no other cauſe, but (as we have touched already) that the fantaſie of the parent, altereth the temper and the diſpoſition of his body and ſeed, according as it ſelfe is tempered and diſpoſed: and conſequently, ſuch a creature muſt be made of it, as retaineth the ſame qualities: in ſuch ſort as it is ſaid that ſufficient tartar put at the root of a tree will make the fruit have a winy taſte.

3. How the parents fantaſie doth oftentimes worke ſtrange effects in their iſſue.

But nothing doth confirme this ſo much, as certain notable accidents, whereof though every one in particular would ſeeme incredible, yet the number of them, and the weight of the reporters, who are the witneſſes, cannot chooſe but purchaſe a generall credit to the kinde of them. Theſe accidents are, that out of ſome ſtrong imagination of the parents, but eſpecially of the mother, in the time of conception, the children draw ſuch maine differences as were incredible, if the teſtifying authority were not ſo great: but being true, they convince beyond all queſtion the truth wee have propoſed, of the parents imagination working upon, and making an impreſsion in the ſeed, whereof children or young ones of their kinde are made. Some children of white parents are reported to have been black upon occaſion of a blacke moores picture too much in the mothers eye. Others are ſaid to have been born with their skins all hairy out of the ſight of St. *Iohn Baptiſts* picture as hee was in the deſart, or of ſome other hairy image. Another childe is famed to have been borne deformed, in ſuch ſort as Divels are painted, becauſe the father was in a Divels habit when hee got the childe.

There was a Lady a kinſwoman of mine, who uſed much to weare black patches upon her face (as was the faſhion among young women) which I to put her from, uſed to tell her in jeſt, that the next childe ſhe ſhould goe with, whiles the ſollicitude and care of thoſe patches was ſo ſtrong in her fantaſie, would come into the world with a great black ſpot in the midſt of its fore-head: and this apprehenſion was ſo lively in her imagination at the time ſhe proved with childe, that her daughter was borne marked juſt as the mother had fanſied, which there

there are at hand witneſſes enough to confirm; but none more pregnant, then the young Lady her ſelfe, upon whom the marke is yet remaining. Among other creatures, it is ſaid that a hen hatched a chicken with a Kites bill, becauſe ſhee was frighted with a Kite, whiles the Cocke was treading her. The ſtory of *Jacobs* ſheepe is knowne to all: and ſome doe write, that the painting of beautifull coloured pigeons in a dove-houſe, will make the following race become like them: and in Authors ſtore of ſuch examples may be found.

To give a reaſonable and fully ſatisfying cauſe of this great effect, I confeſſe is very difficult; ſeeing that for the moſt part, the parents ſeed is made long time before the accoupling of the male and female: and though it were not, we ſhould be mainly to ſeeke for a rationall ground to diſcourſe in particular upon it. Yet not to leave our Reader without a hinte which way to drive his inquiſition, we will note thus much, that Ariſtotle and other naturall Philoſophers and Phyſitians doe affirme, that in ſome perſons the paſsion is ſo great in the time of their accoupling, that for the preſant it quite bereaveth them of the uſe of reaſon; and that they are for the while, in a kind of ſhort fit of an epilepſie. By which it is manifeſt, that aboundance of animall ſpirits doe then part from the head, and deſcend into thoſe parts which are the inſtruments of generation. Wherefore, if there be aboundance of ſpecieſes of any one kind of object then ſtrong in the imagination, it muſt of neceſsity be carryed downe together with the ſpirits into the ſeed: and by conſequence, when the ſeed infected with this nature, beginneth to ſeparate and diſtribute it ſelfe, to the forming of the ſeverall parts of the Embryon, the ſpirits which doe reſort into the braine of the childe (as to their proper Element) and from thence doe finiſh all the outward caſt of its body (in ſuch ſort as wee have above deſcribed) doe ſometimes happen to fill certaine places of the childes body, with the infection and tincture of this object; and that according to the impreſsion with which they were in the mothers fantaſie: for ſo wee have ſaid, that things which come together into the fantaſie, doe naturally ſticke together in the animall ſpirits. The hairineſſe therefore will be occaſioned in thoſe parts, where the Mother fanſied it to be:

be: the colour likewiſe, and ſuch extancies or defects, as may any way proceed from ſuch a cauſe, will happen to be in thoſe parts, in which they were fanſied. And this is as farre, as is fit to wade into this point, for ſo generall a diſcourſe as ours is; and more then was neceſſary for our turne: to the ſerving whereof, the verity of the fact onely, and not the knowledge of the cauſe, was required: for wee were to ſhew no more, but that the apprehenſions of the parents, may deſcend to the children.

Out of this diſcourſe, the reaſon appeareth, why beaſts have an averſion from thoſe, who uſe to doe them harme: and why this averſion deſcendeth from the old ones to their brood; though it ſhould never have happened that they had formerly encountred with, what at the firſt ſight they flye from and avoid.

4. Of Antipathies.

But yet the reaſon appeareth not, why (for example) a ſheep in England (where there are no wolves bred, nor have been theſe many ages) ſhould be afraid, and tremble at ſight of a Wolfe, ſince neither he, nor his damme or ſire, nor theirs in multitudes of generations, ever ſaw a wolfe, or received hurt by any. In like manner, how ſhould a tame weaſell brought into England from Ireland (where there are no poyſonous creatures) be afraid of a toad as ſoone as he ſeeth one? Neither he, nor any of his race, ever had any impreſſions following harme, made upon their fantaſies: and as little can a Lyon receive hurt from a houſhold Cocke: therefore we muſt ſeeke the reaſons of theſe and ſuch like antipathies a little further and we ſhall find them hanging upon the ſame ſtring, with ſympathies proportionable to them.

Let us goe by degrees: wee daily ſee that dogges will have an averſion from Glovers, that make their ware of dogs skins: they will barke at them, and be churliſh to them, and not endure to come neere them, although they never ſaw them before. The like hatred they will expreſſe to the dogge killers in the time of the plague, and to thoſe that flea dogges. I have known of a man that uſed to be imployed in ſuch affaires, who paſſing ſometimes over the grounds neere my mothers houſe (for hee dwelled at a village not farre off) the dogges would

would winde him at a very great distance, and would all runne furiously out the way he was, and fiercely fall upon him; which made him goe alwayes well provided for them: and yet hee hath been sometimes hard put to it, by the fierce Mastifes there, had it not been for some of the servants coming in to his rescue; who by the frequent happening of such accidents, were warned to looke out when they observed so great commotion and fury in the dogges, and yet perceived no present cause for it. Warreners observe, that vermin will hardly come into a trap wherein another of their kinde hath been lately killed: and the like happeneth in Mouse-traps, into which no Mouse will come to take the baite, if a Mouse or two have already beene killed in; unlesse it be made very cleane, so that no scent of them remaine upon the trap: which can hardly be done on the sudden otherwise then by fire.

It is evident, that these effects are to be referred to an activity of the object upon the sense; for some smell of the skinnes, or of the dead dogges, or of the vermine, or of the Mice, cannot choose but remaine upon the men and upon the traps; which being altered from their due nature and temper, must needs offend them. Their conformity on the one side (for somthing of the canine nature remaineth) maketh them have easie ingression into them; and so they presently make a deep impression: but on the other side, their distemper from what they should be, maketh the impresion repugnant to their nature, and be disliked by them, and to affect them worse, then if they were of other creatures, that had no conformity with them: as we may observe, that stinkes offend us more, when they are accompanied with some weake perfume, then if they set upon us single; for the perfume getteth the stinke easier admittance into our sense: and in like manner, it is said that poysons are more dangerous, when they are mingled with a cordiall that is not able to resist them: for it serveth to convey them to the heart, though it bee not able to overcome their malignitie.

From hence then it followeth, that if any beast or bird doe prey upon some of another kinde, there will be some smell about them, exceedingly noysome to all others of that kinde:

and

and not onely to beasts of that same kinde; but (for the same reason) even to others likewise, that have a correspondence and agreement of temper and constitution with that kinde of beast, whose hurt is the originall cause of this aversion. Which being assented unto, the same reason holdeth to make those creatures, whose constitutions and tempers doe consist of things repugnant and odious to one another, be at perpetuall enmity, and flye from one another at the first sight, or at the least, the sufferer from the more active creature: as we see among those men, whose unhappy trade and continuall exercises it is to empty jakeses, such horrid stinkes are by time growne so conformable to their nature, as a strong perfume will as much offend them, and make them as sicke, as such stinkes would doe another man bred up among perfumes: and a cordiall to their spirits, is some noysome smell, that would almost poyson another man. And thus, if in the breath of the Wolfe, or in the steame comming from his body, be any quality offensive to the Lambe (as it may very well be, where there is so great a contrariety of natures) it is not strange, that at the first sight and approach of him, he should be distempered and flye from him; as one fighting cocke will doe from another, that hath eaten garlike: and the same happeneth between the weasell and the toad; the lyon and the cocke, the toade and the spider, and severall other creatures, of whom like enmities are reported.

All which are caused in them, not by secret instincts, and antipathies, and sympathies, whereof we can give no account; (with the bare sound of which words, most men doe pay themselves, without examining what they meane;) but by downeright materiall qualities, that are of contrary natures, (as fire and water are) and are either begotten in them in their originall constitution, or are implanted in them afterwards by their continuall food, which nourishing them, changeth their constitution to its complexion. And I am perswaded this would goe so farre, that if one man were nourished continually with such meate (and greedily affected it) which another had aversion from, there would naturally follow much dislike betweene them; unlesse some superiour regard should master this

this averſion of the ſenſe. And I remember to have ſeene two notable examples of it: the one in Spaine, of a Gentleman that had a horrour to garlike, who (though he was very ſubject to the impreſſions of beauty) could never weane himſelfe from an averſion he had ſetled him to a very handſome woman, that uſed to eate much garlik, though to win him, ſhe forbore the uſe of that meate, which to her was the moſt ſavoury of all others. And the like I knew in England between two, whereof the one did extreamly love cheeſe, and the other as much hated it, and would fall into a ſtrange agony, and be reduced (one would thinke) to the point of death, if by inadvertence or others tryall of him, he had ſwallowed never ſo little, of what the other would have quitted all meates elſe to live upon.

And not onely ſuch averſions, as ſpring from differences of complexions in the conſtitutions of ſeverall animals, doe cauſe theſe effects of feare, and of trembling, and of flying from thoſe that do make ſuch impreſſions; but even the ſeeing them angry and in fury doth the like: for ſuch paſſions do alter the ſpirits; and they iſſuing from the body of the animall in paſſion, cannot chooſe but be received by another in a different manner, then if they were of another temper. Then if the one kinde be agreeable to their nature, the other muſt needs be diſpleaſing. And this may be the reaſon why Bees never ſting ſuch as are of a milde and gentle diſpoſition; and will never agree with others, that are of a froward and angry nature. And the ſame one may obſerve among dogges: and peradventure, a mans fantaſie may bee raiſed to ſuch a height of fury, that the fierceſt beaſts may be afraid to look upon him; and cannot endure that thoſe maſtering ſpirits, which ſtreame out of the mans eyes, ſhould come into his; ſo much they diſtemper his fantaſie: and therefore he will turne away from the man, and avoid him. Which diſcourſe may be confirmed by ſundry examples of lyons and beares, that have runne from angry and confident men, and the like. Since then, a man that is in his naturall hew giveth no diſtaſte, doth ſo much affright fierceſt beaſtes, when hee putteth on his threatning lookes; it is no wonder, that beaſtes of a milder and ſofter nature, ſhould have feare of him

him ſettled in them, when they never ſaw him otherwiſe then angry, and working miſchiefe to them. And ſince their brood do receive from their parents, a nature eaſily moved unto feare or anger, by the ſight of what moved them, it is not ſtrange, that at the firſt ſight they ſhould tremble or ſwell, according as the inward motion of the ſpirits affordeth.

Now if this hath rendered the Birds in the wilde Iſlandes affraide of men, who otherwiſe would be indifferent to them, it is no marvaile to ſee more violent effects in the Lambes averſion from the Wolfe, or in the Larkes from the Hobbey; ſince they peradventure have over and above the hurt they uſe to do them, a difformity in their conſtitutions: and therefore, though a Larke will flie as well from a man as from a Hobbey, yet becauſe there is one cauſe more for his diſlike againſt the Hobbey, then againſt the man (namely the difformity of their conſtitutions) hee will flie into the mans hand, to avoid the Hawkes talons.

Unto ſome of theſe cauſes all antipathies may be reduced: and the like reaſon may be given for the ſympathies we ſee between ſome creatures. The little corporeities which iſſue from the one, have ſuch a comformity with the temper of the other, that it is thereby moved to joyn it ſelfe unto the body from whence they flow, and affecteth union with it in that way, as it receiveth the impreſſion. If the ſmell do pleaſe it, the beaſt will alwayes be ſmelling at it: if the taſt, nothing ſhall hinder it from feeding upon it when it can reach it. The fiſhermen upon the banke over againſt Newfound Land, do report that there flocketh about them a kind of Bird, ſo greedy of the fiſhes livers which they take there, as that to come at them and feed upon them, they will ſuffer the men to take them in their hands; and will not flie away, as long as any of their deſired meate is in their eye: whence the French men that fiſh there, do call them *Happe Foyes*. The like power, a certaine Worme hath with Nightingales. 5. Of Sympathies.

And thus you ſee, how they are ſtrong impreſſions upon ſenſe, and not any diſcourſe of reaſon, that do governe beaſts in their actions: for if their avoyding men, did proceed from any ſagacity in their nature, ſurely they would exerciſe it, when they ſee

see that for a bit of meate they incurre their destruction: and yet neither the examples of their fellowes killed before their eyes in the same pursuite, nor the blowes which themselves do feele; can serve them for warning, where the sense is so strongly affected: but as soone as the blow that removed them is passed, (if it misse killing or laming them) and they be gotten on wing againe, they will returne to their prey as eagerly and as confidently, as if nothing were there to hinder them.

6. That the Antipathy of Beasts towards one an other, may be taken away by assuefaction.

This then being the true reason of all sympathy and antipathy, we cannot admit that any beasts should love or hate one an other, for any other cause, then some of those wee have touched. All which are reduced to locall motion, and to materiall application of bodies of one nature, to bodies of an other; and are as well transmitted to their young ones, as begotten in themselves: and as the satisfying of their sense, is more prevalent in the *Happe foyes*, then the feare which from other grounds is begotten in their fantasy; and so maketh them approach to what the other would drive them from.

In like manner, any aversion of the fantasy may be mastered not onely by a more powerfull agent upon the present sense, but also by assuefaction, and by bringing into the fantasy with pleasing circumstances that object which before was displeasing and affrightfull to it: as we see that all sorts of Beasts or Birds, if they be taken young may be tamed and will live quietly together. Dogges that are used to hunt and kill Deere, will live friendly with one that is bred with them; and that Fawne which otherwise would have bin affraid of them, by such education groweth confident and playeth boldely with them. Of which we can no longer remaine in doubt, if we will believe the story of a Tyger (accounted the cruellest beast of all others) who being shut up with a Deere, that had bin bred with him from a Kid and from his being a whelpe; and no meate given him, used meanes to break prison, when he was halfe starved, rather then he would hurt his familiar friend. You will not suspect, that it was a morall consideration, which made him so kinde: but the Deere had never come into his fantasy

taſie accompanied with other circumſtances, then of play or of warmth: and therefore hunger (which calleth onely the ſpecies of meate out of the memory into the fantaſy) would never bring the Deere thither, for remedy of that paſſion.

And that which often happeneth to thoſe men, in whom the fantaſie onely worketh, is not much unlike to this: among whom I have ſeene ſome frenticke perſons, that if they be perſwaded they are tyed, and cannot ſtirre from the place where they are; they will lye ſtill, and make great complaints for their impriſonment; and not goe a ſteepe, to reach any meate or drinke, that ſhould lye in ſight neere them, although they were never ſo much preſſed with hunger or with thirſt. The reaſon is evident, for the apprehenſion of being tyed, is ſo ſtrong in their fantaſie, that their fantaſie can ſend no ſpirits into other parts of their body, whereby to cauſe motion.

And thus the deere was beholding to the tygars fantaſie, not to his diſcourſe of morall honeſty, for his life. The like of this tygar and deere, is to be ſeene every day in the tower of London; where a little dogge, that was bred with a lyon from his birth, is ſo familiar and bold with them, that they not onely ſleep together, but ſometimes the dog will be angry with him, and will bite him; which the lyon never reſſenteth from him, though any other dogge that is put to him, he preſently teareth in pieces.

And thus we plainely ſee, how it commeth about, that beaſts may have ſtrange averſions from things, which are of annoying or deſtructive nature to them, even at the firſt ſight of them: and againe, may have great likings of other things, in a manner contrary to their nature, without needing to allow them reaſon, whereby to diſcourſe and judge what is hurtfull to them or to inſtruct the tyger we have ſpoken of, or Androdus his lyon, the duties of friendſhip and of gratitude.

7. Of longing markes ſeen in children.

The longing markes which are oftentimes ſeen in children, and doe remaine with them all their life, ſeeme to bee an offſpring of the ſame root or cauſe: but in truth, they proceed from another, although of kinne to this: for the operation of the ſeed is paſſed, when theſe longing markes are imprinted;

the childe being then already formed and quickened; and they seeme to be made suddenly, as by the print of a seale. Therefore to render the cause of them, let us consider another sympathy which is more plain and common. We see that the laughing of one man, will set another on laughing that seeth him laugh, though he know not the cause why the first man laugheth: and the like we see in yawning and stretching, which breedeth the like effect in the looker on. I have heard of a man, that seeing a rosted pigge, after our English fashion with the mouth gaping, could not shut his owne mouth as long as hee looked upon the pigges: and of another, that when he saw any man make a certaine motion with his hand, could not choose but he must make the same: so that, being a tyler by his trade, and having one hand imployed with holding his tooles whiles he held himselfe with the other upon the eaves of a house hee was mending, a man standing below on the ground, made that sign or motion to him; whereupon he quitted his holdfast to imitate that motion, and fell downe, in danger of breaking his necke.

All these effects, doe proceed out of the action of the seene object upon the fantasie of the looker on: which making the picture or likenesse of its own action in the others fantasie, maketh his spirits runne to the same parts; and consequently, move the same members, that is, doe the same actions. And hence it is, that when we heare one speake with love and tendernesse of an absent person, we are also inclined to love that person, though we never saw him, nor heard of him before: and that whatsoever a good Oratour delivereth well, (that is, with a semblance of passion agreeable to his words) raiseth of its owne nature, like affection in the hearers: and that generally men learne and imitate (without designe) the customes and manners of the company they much haunt.

To apply this to our intent, it is easie to conceive, that although the childe in the mothers wombe, can neither see nor heare what the mother doth, nevertheless there can not passe any great or violent motion in the mothers body, whereof some effect doth not reach unto the childe, which is then, one continuate piece with her: and the proper effect of motion or

of

of trembling in one body, being to produce a like motion or a trembling in another, (as wee see in that ordinary example of tuned strings, whereof the one is moved at the striking of the other, by reason of the stroake given to the ayre, which finding a moveable easily moved with a motion of the same tenour, communicateth motion unto it) it followeth that the fantasie of the childe, being as it were well tuned to the fantasie of the mother, and the mothers fantasie making a speciall and a very quicke motion in her owne whole body, (as wee see that sudden passions doe) this motion or trembling of the mother, must needs cause the like motion and trembling in the childe, even to the very swiftnesse of the mothers motion. Now as we see when one blusheth, the blood cometh into his face, so the blood runneth in the mother to a certaine place, where she is strucken by the thing longed for: and the like happening to the childe, the violence of that sudden motion, dyeth the marke or print of the thing in the tender skin of it: the blood in some measure pierting the skin, and not returning wholly into its naturall course: which effect is not permanent in the mother, because her skinne being harder, doth not receive the blood into it, but sendeth it backe againe, without receiving a tincture from it.

8. Why divers men hate some certaine meats, and particularly cheese.

Farre more easie is it, to discover the secret cause of many antipathies or sympathies, which are seen in children, and endure with them the greatest part, if not the whole terme of their life, without any apparent ground for them: as some doe not love cheese, others garlike, others ducks, others divers other kindes of meate, which their parents loved well; and yet in token that this aversion is naturall unto them, and not arising from some dislike accidentally taken and imprinted in their fantasie, they will be much harmed if they chance to eate any such meate; though by the much disguising it, they neither know, nor so much as suspect they have done so. The story of the Lady *Hennage*, (who was of the bed-chamber to the late Queene *Elizabeth*) that had her cheeke blistered by laying a rose upon it whiles shee was asleepe, to try if her antipathy against that flower, were so great as she used to pretend, is famous in the Court of England. A Kinsman of mine, whiles

he was a child, had like to have died of drought, before his nurse came to understand, that he had an antipathy against Beer or Wine; untill the tender nature in him, before he could speak, taught him to make earnest signes for water, that by accident he saw; the greedy drinking of which, cured presently his long languishing and pining sickness: and such examples are very frequent.

The cause of these effects many times is, that their mothers, upon their first suppression of their usuall evacuations, by reason of their being with child) took some strong dislike to such things, their stomacks being then oppressed by unnatural humors, which overflow their bodies upon such retentions; and which make them oftentimes sick and prone to vomiting, (especially in the mornings, whiles they are fasting) and sometimes to desire earnestly (which they call *longing*) to feed upon some unwholesome, as well as some particular wholesome things; and other whiles, to take aversion against meates, which at other seasons they affected well. Now the child being nourished by the so imbued bloud of the mother, no wounder if it taketh affections or dislikes, conformable to those which at that present raigne in the mother: the which for the most part used to be purged away, or are overwelmed by the mastering qualities of better aliments succeeding: but if by some mischance, they become too much grafted in the childs stomack, or in some other part, through which the masse of bloud must passe; then the child getteth an aversion from those meats: and we often see, that people retaine a strong conversion to such meates or drinks, as their mothers affected much or longed for, whiles they bred child of them.

And thus we will leave this particular; adding only one note, why there are more persons generally, who have antipathy against cheese, then against any one sort of meate besides whatsoever. A principall reason of which symptome (where the precedent one hath not place) I conceive to be, that their nurses proved with child, whiles they gave them suck: for I have by experience found it to have been so, in as many as I have made inquiry into. And it is very conformable to reason; for the nurses milk, crudling in her brest upon her breeding of child, and becomming very offensive to the childes tender stomack, (whose being sick, obligeth

obliged the parents to change the Nurse, though peradventure they know nothing of the true reason that maketh her milke unnaturall) he hath a dislike of Cheese (which is strong curdled milk) ever after settled in him; as people that have once surfeited violently of any meate, seldome arrive to brooke it againe.

9. Concerning the providence of Aunts in laying up in store for winter.

Now, as concerning those Animals who lay up in store for winter, and seem therein to exercise a rationall providence; who seeth not, that it is the same humour, which moveth rich misers to heap up wealth, even at their last lasp, when they have no child nor friend to give it to, nor think of making any body their heires? Which actions because they have no reason in them, are to be imputed to the passion or motion of the materiall appetite. In the doing of them, these steppes may be observed; first the object presenting it selfe to the Eye, provoketh love and desire of it; especially if it be joyned with the memory of former want: then this desire stirreth up the animall (after he hath fed himselfe) to gather into the place of his chief residence, as much of that desired object as he meeteth withall; and whensoever his hunger returning, bringeth back into his fantasy the memory of his meate, it being joyned with the memory of that place (if he be absent from it) he presently repaireth thither, for relief of what presseth him: (and thus Dogs when they are hungry, do rake for bones they had hidden when their bellies were full.) Now if this food, gathered by such providence (which is nothing else, but the conformity of it, working upon him by his sense) and layed up in the place, where the owner of it resideth, (as the corne is, which the Aunts gather in summer) be easily portable, he will carry it abroad with him the first time he stirreth after a long keeping in; for then nothing worketh so powerfully in his fantasy, as his store; and he will not easily part from it, though other circumstances invite him abroad. From hence it proceedeth, that when a faire day commeth after long foule weather, the Aunts, who all that while kept close in their dennes with their corne lying by them, do then come abroad in the Sun, and do carry their graine along with them: or peradventure it happeneth, because the precedent wet weather, hath made it grow hot, or musty, or otherwise

wise offensive within; and therefore they carry it out, as soon as themselves dare peepe abroad; which is, when the faire weather, and heate of the day, inviteth them out into the open ayre: and before night that they rerurne into their holes, the offensive vapors of the corne are exhaled and dryed up, and move their fantasies no longer to aversion, whereupon they carry it back againe; having then nothing but their long contracted love unto it to work upon them. The like whereof men doing by discourse, to ayre their corne, and to keep it sweet, and the same effect following herein, they will presently have it, that this is done by the Aunts, for the same reason, and by designe. Then the moysture of the earth swelling the graine, and consequently, making it begin to shoot at the ends (as we declared, when we spoke of the generation of plants, and as we see in the moystening of corne to make malt of it) those little creatures, finding that part of it more tender and juycy then the rest, do nibble upon it there, and do feed themselves first with that, which consequently hindereth the groweth of the corne. And here againe, men will contend that this must be done by providence and discourse, to prevent that their store should not grow out of their reach, and changing nature, become useless to them in their need.

10. Concerning the foreknowing of Beasts.

To conclude, the foreknowing of beasts is nothing else, but their timely receiving impressions, from the first degrees of mutation in things without them; which degrees are almost imperceptible to us, because our fantasies and spirits have otherwise such violent agitations, more then theirs, which hinder them from discerning gentle impressions upon them. If you be at Sea, after a long calme, a while before a gale bloweth to fill your sailes, or to be discernable by your sense in quality of wind, you shall perceive the Sea begin to wrinkle his smooth face that way the wind will come; which is so infallible a signe that a gale will come from that coast, as mariners immediately fall to trimming their sailes accordingly; and usually before they can have done, the wind is with them: shall we therefore say that the Sea hath a providence to foresee which way the wind will blow? Or that the corns upon our toes, or callouses, or broken bones or joynts that have been dislocated, have discourse, and can foretell,

tell the weather? It is nothing elſe, but that the wind riſing by degrees, the ſmooth Sea is capable of a change by it, before we can feele it: and that the Aire, being changed by the forerunners of worſe weather, worketh upon the craſieſt parts of our body when the others feele not ſo ſmall a change: ſo beaſts are more ſenſible then we (for they have leſſe to diſtract them) of the firſt degrees of a changing weather: and that mutation of the Aire without them, maketh ſome change within them, which they expreſſe, by ſome outward actions or geſtures.

Now they who obſerve, how ſuch mutations and actions are conſtantly in them, before ſuch or ſuch weather, do think they know beforehand, that raine (for example) or wind, or drought is comming, according to the ſeverall ſignes they have marked in them: which proceedeth out of the narrowneſſe of their diſcourſe, that maketh them reſort to the ſame cauſes, whenſoever they meet with like effects: and ſo they conceive, that things muſt needs paſſe in beaſts, after the ſame tenour, as they do in men. And this is a generall, and maine errour, running through all the conceptions of mankind, unleſſe great heed be taken to prevent it, that what ſubject ſoever they ſpeculate upon, whether it be of ſubſtances, that have a ſuperiour nature to theirs, or whether it be of creatures inferiour to them, they are ſtil apt to bring them to their own ſtandard, and to frame ſuch conceptions of them, as they would do of themſelves: as when they will have Angels diſcourſe, and move, and be in a place, in ſuch ſort as is naturall to men; or when they will have beaſts rationate and underſtand, upon their obſerving ſome orderly actions performed by them, which in men would proceed from diſcourſe and reaſon. And this dangerous Rock (againſt which many fine conceptions do ſuffer ſhipwrack) whoſoever ſtudieth truth, muſt have a maine caution to avoyde.

*Sed nos immenſum ſpatiis confecimus æquor:*
*Et jam tempus equum fumantia ſolvere colla.*

# THE CONCLVSION OF THE *FIRST TREATISE.*

THus at the last (by Gods assistance) we have climbed up to the top of the hill; from whence looking downe over the whole region of bodies, we may delight our selves, with seeing what a height the weary steps we ascended by, have brought us unto. It is true, the path we have walked in, is of late so untrodden, and so overgrowne with bryars, as it hath not been without much labour, that we have made our way through. And peradventure, it may seem toylesome unto others to follow us, especially such as are not much enured to like journeys: but I hope, the fruit which both we and they are now arrived to gather of our paines, in this generall view we have taken of the empire of matter, and of corporeall agents, is such, as none of us hath reason to be ill satisfied with the imploying of them. For what can more powerfully delight, or more nobly entertaine an understanding soule, then the search and discovery of those workes of nature, which being in their effects so plainly exposed to our eyes, are in their causes so abstruse and hidden from our comprehension, as (through despaire of successe) they deter most men from enquiring into them?

And

And I am perſwaded, that by this ſummary diſcourſe (ſhort indeed, in regard of ſo large a ſcope, how ever my lame expreſſions may peradventure make it appeare tedious) it appeareth evidently, that none of natures greateſt ſecrets, whereof our ſenſes give us notice in the effects, are ſo overſhaded with an impenetrable veile, but that the diligent and wary hand of reaſon might unmaske them and ſhew them to us, in their naked and genuine formes, and delight us with the contemplation of their native beauties; if we had as much care and conſtancy in the purſuit of them, as wee daily ſee men have in heaping up of wealth, or in ſtriving to ſatisfie their boundleſſe ambitions; or in making their ſenſes ſwimme in the muddy lake of baſe and contemptible pleaſures. For who ſhall throughly conſider and weigh what we have hitherto ſaid, will plainly ſee a continuall and orderly progreſſe, from the ſimpleſt, higheſt, and moſt common conception, that we frame of a body in generall, unto the furtheſt and moſt abſtruſe effects, that in particular are to be found in any body whatſoever: I meane, any that is meerely corporeall, without mixture of a nobler nature; for hitherto we have not moved, nor ſo much as looked out of that Orbe: He ſhall finde one continued thread, ſpunne out from the beginning to the end. He will ſee, that the various twiſting of the two ſpecieſes of *Bodies*, *Rare*, and *Denſe*, do make the yarne, of which all things and actions within the ſphere of matter are woven.

And although peradventure, in the drawing out of the thread, there may be ſome little brackes, or the ſtuffe made of it be not every where ſo cloſe wrought, as a better workman at more leiſure might have done; yet truly, I believe, that the very conſent of things throughout is ſuch, as demonſtrateth, that the maine contexture of the doctrine I have here touched, is beyond quarrelling at. It may well be that in ſundry particulars, I have not lighted upon exact truth: and I am ſo farre from maintaining peremptorily any thing I have here ſaid, as I ſhall moſt readily hearken to whatſoever ſhall be objected againſt it; and be as ready upon cauſe, to deſert my owne opinions, and to yeeld unto better reaſon. But withall, I conceive,

ceive, that as the falling of a bricke here and there in the rearing of the walls of a house, doth nothing at all prejudice the strength and security of the fabricke; no more (I hope) will the slight escapes, which so difficult a taske as this is subject unto, endamage or weaken the maine body of what I have here delivered. I have not yet seen any piece upon this subject, made up with this method, beginning from the simplest and plainest notions, and composing them orderly, till all the principall variety which their nature is capable of, bee gone through: and therefore it cannot be expected, but that the first modell of this kinde (and moulded by one distracted with continuall thoughts of a much different straine; and whose exercise, as well as profession, hath allowed him but little commerce with bookes and study) must needs be very rough hewed, and require a great deale of polishing. Which whosoever shall do, and be as exact and orderly in treating of Philosophy and Theology, as Mathematicians are in delivering their sciencies, I doe assure my selfe, that *Demonstrations* might be made, and would proceed in them as currently, and the conclusions be as certaine and as full, as in the Mathematickes themselves. But that is not all: these demonstrations would have the oddes exceedingly of the other, and bee to us, inestimably more advantagious: for out of them, doe spring much higher and nobler effects, for mans use and life, then out of any Mathematicall ones; especially when they extend themselves to the governement of *Man* as he is *Man*: which is an art, as farre beyond all the rules of Physicke, or other government of our body, or temporall goods, as the end is beyond the meanes wee employ to gaine it; for all the others, doe but serve instrumentally to this end, *That wee may live well:* whereas these doe immediately teach it.

These are the fruits in generall, that I hope may in some measure, grow out of this discourse, in the hands of equall and judicious Readers: but the particular ayme of it, is to shew what actions can proceed from a body, and what cannot. In the conduct whereof, one of our chiefe endeavours hath beene to shew, that those actions which seeme to draw strongly in-

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to the order of bodies, the unknown nature of certaine entities named *Qualities*; either doe or may proceed, from the ſame cauſes, which produce thoſe knowne effects, that all ſides agree, doe not ſtand in need of any ſuch myſticall Philoſophy. And this being the main hinge, upon which hangeth and moveth the full and cleare reſolving of our maine and great queſtion, *Of the immortality of the ſoule*; I aſſure my ſelfe, the paines I have taken in this particular, will not be deemed ſuperfluous or tedious: and withall, I hope I have employed them with ſo good ſucceſſe, as henceforward, wee ſhall not be any more troubled, with objections drawne from their hidden and incomprehenſible nature: and that we ſtand upon even ground, with thoſe of the contrary opinion: for ſince we have ſhewed, how all actions may be performed among bodies without having any recourſe to ſuch *Entities* and *Qualities* as they pretend and paint out to us, it is now their part (if they will have them admitted) to prove that in nature there are ſuch.

Having then brought the Philoſophy of bodies unto theſe termes; that which remaineth for us to performe, is to ſhew that thoſe actions of our ſoule, for which we call her a ſpirit, are of ſuch a nature, as they cannot be reduced into thoſe principles by which all corporeall actions are effected. For the proof of our originall intent, no more then this, can be exacted at our hands; ſo that if our poſitive proofes, ſhall carry us yet beyond this it cannot be denyed, but that we give over meaſure, and doe illuſtrate with a greater light, what is already ſufficiently diſcerned. In our proceeding, we have the precedencie of nature: for laying for our ground, the naturall conceptions which mankinde maketh of quantity; we finde that a body is a meere paſſive thing, conſiſting of divers parts, which by motion may be diverſly ordered; and conſequently, that it is capable of no other change or operation, then ſuch as motion may produce, by various ordering the divers parts of it: and then, ſeeing that *Rare* and *Denſe*, is the primary and adequate diviſion of *Bodies*; it followeth evidently that what cannot bee effected by the various diſpoſition of rare and denſe parts, cannot proceed or bee effected by a pure body

body: and consequently, it will bee sufficient for us to shew, that the motions of our soules are such: and they who will not agree to this conclusion, must take upon them to shew, that our first premisse is defective; by proving that other unknowne waies are necessary, for bodies to be wrought upon, or to worke by: and that the motion, and various ordering of rare and dense parts in them, is not cause sufficient for the effects we see among them. Which whosoever shall attempt to do, must remember that he hath this disadvantage before he beginneth, that whatsoever hath been hitherto discovered in the science of bodies, by the help either of Mathematicks or Physicks, it hath all been resolved, and hath falne into this way which we declare.

Here I should set a period to all further discourse concerning this first Treatise of bodies, did I not apprehend, that the prejudice of Aristotles authority, may dispose many to a harsh conceit of the draught we have made. But if they knew how little reason they have to urge that against us, they would not cry us downe for contradicting that Oracle of nature: not onely because he himselfe, both by word, and by example, exhorteth us, when verity leadeth us another way, to forsake the trackes which our forefathers have beaten for us, so we doe it with due respect and gratitude for the much they have left us: nor yet because Christian Religion, as it will not heare of any man (purely a man) free from sinne, so it inclineth to perswade us, that no man can be exempt from errour; and therefore it savoureth not well, to defend peremptorily any mans sayings (especially if they be many) as being uncontrollable; howbeit I intend not to prejudice any person, that to defend a worthy Authors honour, shall endeavour to vindicate him from absurdities and grosse errours: nor lastly, because it hath ever been the common practise of all grave Peripatetiks and Thomists, to leave their Masters, some in one article, some in another: but indeed, because the very truth is, that the way we take, is directly the same solid way, which Aristotle walked in before us: and they who are scandalised at us for leaving him, are exceedingly mistaken in the matter: and out of

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the ſound of his words (not rightly underſtood) do frame wrong ſenſe of the doctrine he hath left us, which generally we follow.

Let any unpartiall Ariſtotelian anſwer, whether the conceptions we have delivered of *Quantity*, of *Rarity* and *Denſity*, of the *foure firſt Qualities*, of the *combinations* of the *Elements*, of the *repugnance of vacuities*, be not exactly and rigorouſly Ariſtotles? Whether the motion of weighty and light things, and of ſuch as are forced, be not by him, as well as by us, attributed to externe cauſes? In which all the difference betweene us is, that we enlarge our ſelves to more particulars then he hath done. Let any man read his bookes of Generation and Corruption, and ſay whether he doth not expreſſely teach, that mixtion (which he delivereth to be the generation or making of a mixt body) is done *per minima*; that is in our language and in one word, by atomes; and ſignifyeth, that all the qualities, which are naturall qualities following the compoſition of the Elements, are made by the mingling of the leaſt parts or atomes of the ſaid Elements; which is in effect to ſay; that all the nature of bodies, their qualities, and their operations, are compaſſed by the mingling of atomes: the ſhewing and explicating of which hath beene our labour in this whole Treatiſe. Let him read his bookes of Meteors, and judge whether he doth not give the cauſes of all the effects he treateth of there, by mingling and ſeparating of great and little, groſſe and ſubtile, fiery and watery, ayery and earthy parts, juſt as we doe. The ſame he doth in his *Problems*, and in his *Parva naturalia*, and in all other places, whereſoever he hath occaſion to render Phyſically, the cauſes of Phyſicall effects. The ſame doe Hippocrates and Galen: the ſame, their Maſter Democritus; and with them the beſt ſort of Phyſitians: the ſame doe Alchymiſtes, with their maſter Geber; whoſe maxime to this purpoſe, we cited above: the ſame doe all naturall Philoſophers either ancient commentatours of Ariſtotle, or elſe moderne enquirers into naturall effects, in a ſenſible and underſtandable way: as who will take the paines to look into them, will eaſily perceive. Wherefore, let any judicious Reader that hath looked further into Ariſtotle then onely upon

upon his Logicall and Metaphyſicall workes, judge whether in *bulke* our Doctrine bee not conformable to the courſe of his, and of all the beſt Philoſophers that have beene and are; though in *detaile* or particulars, we ſometimes mingle therewith, our owne private judgements: as every one of them, hath likewiſe ſhewed us the way to doe, by the liberty themſelves have taken to diſſent in ſome points from their predeceſſours.

And were it our turne, to declare and teach Logike and Metaphiſickes, we ſhould be forced to goe the way of *matter*, and of *formes*, and of *privations*, in ſuch ſort as Ariſtotle hath trodden it out to us, in his workes of that ſtraine. But this is not our taske for the preſent; for no man that comtemplateth nature as he ought, can chooſe but ſee that theſe notions are no more neceſſary, when we conſider the framing of the elements, then when we examine the making of compounded bodies: and therefore, theſe are to be ſet apart as higher principles, and of another ſtraine, then need be made uſe of for the actuall compoſition of compounded things, and for the reſolution of them in their materiall ingredients, or to cauſe their particular motions; which are the ſubjects we now diſcourſe of.

Upon this occaſion, I thinke it not amiſſe to touch, how the latter ſectatours, or rather pretenders of Ariſtotle, (for truly they have not his way) have introduced a modell of doctrine (or rather of ignorance) out of his words, which he never ſo much as dreamed of; howbeit they alledge texts out of him to confirme what they ſay, as Heretickes doe out of Scripture to prove their aſſertions: for whereas he called certaine collections or poſitions of things, by certaine common names (as the art of Logicke requireth) terming ſome of them *Qualities*, others *Actions*, others *Places*, or *Habites*, or *Relatives*, or the like: theſe his latter followers, have conceited that theſe names did not deſigne a concurrence of ſundry things, or a divers diſpoſition of the parts of any thing, out of which ſome effect reſulted; which the underſtanding conſidering all together, hath expreſſed the notion of it by one name

name: but have imagined, that every one of these names had correspodent unto it, some reall positive entity or thing, seperated (in its owne nature) from the maine thing or substance in which it was, and indifferent to any other substance; but in all unto which it is linked, working still that effect, which is to be expected from the nature of such a *quality*, or *action*, &c. And thus, to the very negatives of things, as to the names of points, lines, instants, and the like, they have imagined positive Entities to correspond: likewise, to the names of *actions*, *places*, and the like, they have framed other Entities: as also to the names of *colours*, *sounds*, *tasts*, *smels*; *touches*, and the rest of the *sensible qualities*, they have unto every one of them, allotted speciall Entities, and generally to all qualities whatsoever. Whereas nothing is more evident, then that Aristotle meaned by *qualities* no other thing, but that disposition of parts, which is proper to one body, and is not found in all: as you will plainly see, if you but examine, what *beauty*, *health*, *agility*, *science*, and such other qualities are; (for by that name he calleth them; and by such examples, giveth us to understand what he meaneth by the word *Quality*) the first of which is nothing else but a composition of severall parts and colours, in due proportion to one another: the next, but a due temper of the humours, and the being of every part of the body, in the state it should be: the third, but a due proportion of the spirits and strength of the sinews: and the last, but ordered Phantasmes.

Now when these perverters of Aristotle have framed such Entities, under that conception which nature hath attributed to substances, they doe immediately upon the nicke, with the same breath that described them as substances, deny them to be substances: and thus they confound the first apprehensions of nature, by seeking learned and strained definitions for plaine things. After which, they are faine to looke for glew and paste to joyne these entities unto the substance they accompany: which they finde with the same facility, by imagining a new entity, whose nature it is to doe that which they have need of.

And

And this is the generall course of their Philosophy; whose great subtilty, and queint speculations in enquiring how things doe come to passe afford no better satisfaction then to say upon every occasion, that there is an *entity* which maketh it be so. As if you aske them, how a *wall is white, or blacke?* They will tell you, there is an *Entity* or *Quality*, whose essence is to be *whitenesse or blackenesse*, diffused through the wall. If you continue to aske, how doth whiteneſse sticke to the wall? They reply, that it is by meanes of an Entity called *Union*, whose nature it is actually to joyne whiteneſse, and the wall together. And then if you enquire how it commeth to passe, that one white is like another? They will as readily answer, that this is wrought by another Entity, whose nature is to be *likeneſſe*, and it maketh one thing like another. The consideration of which doctrine, maketh me remember a ridiculous tale of a trewant schoolboyes latine: who upon a time when he came home to see his friends, being asked by his father, what was latine for *bread?* answered *bredibus*; and for *beere? beeribus*; and the like of all other things he asked him, adding onely a termination in *bus*, to the plaine Englisſh word of every one of them: which his father perceiving, and (though ignorant of Latine) yet presently apprehending, that the mysteries his sonne had learned, deserved not the expence of keeping him at schoole, bad him immediately put off his *hosibus* and *shoosibus*, and fall to his old trade of treading *Morteribus*. In like manner, these great Clerks do as readily finde a pretty Quality or mood whereby to render the nature or causes of any effect in their easie Philosophy, as this Boy did a *Bus* to stamp upon any Englisſh word, and coyne it into his mocklatine.

But to be serious, as the weight of the matter requireth, let these so peremptory pretenders of Aristotle, shew me but one text in him, where he admitteth any middle distinction (such as those moderne Philosophers doe, and must needs admit, who maintaine the qualities we have rejected) betwixt that which he calleth *Numericall*, and that which he calleth of *Reason*, or of *Notion*, or of *Definition*, (the first of which we may terme to be of, or *in things*; the other to be *in our heads*, or *discourses*: or the one

One *Naturall*, the other *Logicall*:) and I will yeeld that they have reaſon, and that I have groſſely miſtaken what he hath written, and that I doe not reach the depth of his ſenſe. But this they will never be able to do.

Beſides the whole ſcope of his doctrine, and all his diſcourſes and intentions, are carryed throughout, and are built upon the ſame foundations, that we have laid for ours. Which being ſo, no body can quarell with us for Ariſtotles ſake; who as he was the greateſt Logician, and Metaphyſician, and univerſall Scholler peradventure that ever lived; and was ſo highly eſteemed, that the good turne which *Sylla* did the world in ſaving his workes, was thought to recompence his many outragious cruelties and tyranny; ſo his name muſt never be mentioned among ſchollers, but with reverence, for his unparalleled worth; and with gratitude, for the large ſtocke of knowledge he hath enriched us with. Yet withall we are to conſider, that ſince his raign was but at the beginning of ſciences, he could not chooſe but have ſome defects and ſhortneſſes, among his many great and admirable perfections.

# THE SECOND TREATISE:

DECLARING,

# THE NATURE AND OPERATIONS OF MANS SOULE;

OUT OF WHICH,

# THE IMMORTALITY OF REASONABLE SOULES, IS CONVINCED.

*Pro captu Lectoris, habent sua fata libelli.*

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LONDON,
Printed in the yeere 1645.

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# The Preface.

*IT is now high time for us to caſt an eye upon the other leaſe of our accounts: or peradventure I may more properly ſay, to fall to the peruſall of our own accounts: for hitherto, our time and paines have been taken up, in examining and caſting the accounts of others: to the end, that from the foot and totall of them, we may drive on our own the more ſmoothly. In ours then, we ſhall meet with a new Capitall; we ſhall diſcover a new World, of a quite different ſtraine and nature from that which all this while we have imployed our ſelves about. We will enter into them, with taking a ſurvay of the great Maſter of all that large family, we have ſo ſummarily viewed: I mean of* Man, *as he is* Man: *that*

*is, not as he is subject to those lawes, whereby other bodies are governed (for therein he hath no præeminence, to raise him out of their throng:) but as he exceedeth the rest of creatures, which are subject to his managing; and as he ruleth over nature her selfe, making her serve his designes; and subjecting her noblest powers to his lawes: and as he is distinguished from all other creatures whatsoever. To the end we may discover, whether that principle in him, from whence those actions doe proceed which are properly his, be but some refined composition, of the same kind we have already treated of: or whether it deriveth its sourse and origine from some higher spring and stocke, and be of a quite different nature.*

*Having then by our former Treatise mastered the oppositions, which else would have taken armes against us, when we should have been in the middest of our edifice; and having cleared the objections which lay in our way, from the perverse* Qualities *of the soules neighbours, the severall common-wealths of Bodies: we must now begin with David to gather together our Materials, and to take a survey of our owne provisions: that so we may proceed with Salomon, to the sacred building of Gods Temple. But before we goe about it, it will not be amisse, that we shew the reason, why we have made our porch so great, and have added so long an entry, that the house is not likely to have thereunto a correspondent bulke: and when the necessity of my doing so, shall appeare, I hope my paines will meet with a favourable censure, and receive a faire admittance.*

*We proposed unto our selves to shew that our* soules are immortall: *whereupon, casting about to finde the grounds of* immortality, *and discerning it to be a negative, we conceived that we ought to begin our search, with enquiring* what mortality *is; and what be the causes of it. Which*

*when*

*when we should have discovered, and have brought the soule to their test, if we found they trenched not upon her, nor any way concerned her condition, we might safely conclude, that of necessity she must be immortall. Looking then into the causes of mortality, we saw that all bodies round about us were mortall: whence perceiving that mortality extended it selfe as farre as corporeity, we found our selves obliged, if we would free the soule from that law, to shew that she is not corporeall. This could not be done without enquiring what corporeity was. Now it being a rule among Logitians, that a definition cannot be good, unlesse it comprehend and reach to every particular of that which is defined; we perceived it impossible to know compleatly, what a* Body *is, without taking a generall view of all those things which we comprise under the name and meaning of* Bodies. *This is the cause we spent so much time in the first Treatise: and I hope to good purpose; for there we found that the nature of a Body, consisted in being made of parts: that all the differencies of bodies are reduced to having more or lesse parts, in comparison to their substance, thus and thus ordered: and lastly, that all their operations, are nothing else but locall motion, which followeth naturally out of having parts. So it appeareth evidently from hence, that if any thing have a beeing, and yet have no parts, it is not a body, but a substance of another quality and condition: and consequently, if we can finde the soules Being to be without parts, and that her operations are no locall translation; we evidently conclude her to be an immateriall or spirituall substance.*

*Peradventure it may be objected, that all this might have been done a much shorter way then we have taken; and that we needed not have branched our discourse, into so many particulars, nor have driven them so home, as we have done: but that we might have taken our first rise from this ground,*

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(which is as evident, as light of reason can make it) that seeing we know bigneſſe and a Body, to be one and the ſame, as well in the notion as in the thing; it muſt of neceſſity follow, that what hath not parts, nor worketh, nor is wrought upon by diviſion, is not a body. I confeſſe, this objection appeareth very reaſonable, and the conſideration of it weighed ſo much with me, as, were all men of a free judgement, and not imbued with artificiall errours, I would for its ſake, have ſaved my ſelfe a great deale of paines: but I finde (as in the former Treatiſe I have frequently complained of) that there is crept into the world a fanſie ſo contrary to this pregnant truth, and that it is ſo deeply ſetled in many mens minds (and not of the meaneſt note) as all we have ſaid is peradventure too little to root it out.

If any that being ſatisfied with the rationall maxime we even now mentioned, and therefore hath not deemed it needfull to imploy his time in reading the former Treatiſe, ſhould wiſh to know how this is come to paſſe, I ſhall here repreſent unto him, the ſumme of what I have more at large ſcattered in ſeverall places of the former Treatiſe; and ſhall intreat him to conſider, how nature teacheth us to call the proprieties of things whereby one is diſtinguiſhed from another, the Qualities of thoſe things; and that according to the varieties of them, they have divers names futed out to divers of them; ſome being called Habits, others Powers, and others by other names. Now what Ariſtotle, and the learned Grecians did meane by theſe things is cleere by the examples they give of them: they terme Beauty and Health, Habits: the diſpoſitions of our bodies to our bodily motions, Powers; as ſtrength (which is the good temper of the ſinewes) a Power; likewiſe Agility, a Power; ſo they uſe the names of the concoctive, the nutritive, the retentive, the excretive, Power; the health of the eyes, the eares, the noſethrils, &c. they

they call the Powers of Seeing, of Hearing, of Smelling, &c. and the like of many others. But latter Philosophers, being very disputative, and desiring to seeme ignorant of nothing (or rather, to seeme to know more then any that are gone before them, and to refine their conceptions) have taken the notions, which by our first Masters were set for common and confused explications of the natures, (to serve for conveniency and succinctenesse of discourse) to bee truly and really particular Entities, or things of themselves: and so have filled their Bookes, and the Schooles, with unexplicable opinions, out of which no account of nature can be given: and which is worse, the way of searching on, is barred to others; and a mischievous error is growne into mens beliefes, that nothing can be knowne. By this meanes they have choaked the most plaine and evident definition of a Body; bringing so many instances against it, that unwary men are forced to desert and deny the very first notions of nature and reason: for in truth, they turne all bodies into spirits, making (for example) heate, or cold, to be of it selfe indivisible, a thing by it selfe, whose nature is not conceivable; not the disposition or proportion of the parts of that body which is said to be hot or cold; but a reall thing, that hath a proper Being and nature peculiar to it selfe; whereof they can render you no account: and so may as well be against the notion of a body as not: for if light, the vertue of the loadestone, the power of seeing, feeling, &c. be things that worke without time, in an instant; if they be not the dispositions of parts as parts, (whose nature is, to be more or lesse, to be next or farre off, &c.) how can it be truly said, that the notion of a body, is to be of parts? For if this be a true definition of a body, it followeth that all corporeall qualities and actions must likewise be some disposition and order of parts as parts: and that what is not so, is no body, nor bodily quality or propriety.

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*This then was it that obliged mee to go so farre about, and to shew in common, how all those effects which are so much admired in bodies, are, or may be made and continued by the sole order of quantitative parts and locall motion: this hath forced us to anatomize nature, and to beginne our dissection, with what first occurreth unto our sense from a body. In doing which, out of the first and most simple notion of* Biggenesse *or* Quantity, *we found out the prime division of* Bodies *into* rare *and* Dense: *then finding them to be the Qualities of* dividing *and of being* divided (*that is, of* locall motion) *wee gained knowledge of the common properties of* Gravity *and* Levity: *from the combination of these wee retrived the* foure first Qualities: *and by them, the* Elements. *When wee had agreed how the elements were made, we examined how their action and composition raiseth those* second qualities, *which are seene in all mixt bodies, and do make their divisions. Then e proceeding into* the operations of life, *wee resolved they are composed and ordered meerely by the varieties of the former: nay, that* sense *and* fantaly (*the highest things we can discerne out of man*) *have no other source, but are subject to the Lawes of parts and of Rarity and Density; so that in the end wee became assured of this important Maxime:* That nothing whatsoever wee know to bee a Body, can be exempted from the declared Laws, and orderly motions of Bodies: *unto which, let us adde two other positions, which fell also within our discovery: the first that it is constantly founded in nature,* that none of the bodies we know, do move themselves; but their motion must be founded in some thing without them: *the second,* that no body moveth an other, unlesse it selfe be also moved: *and it will follow evidently out of them, (if they be of necessity and not prevaricable) that some other Principle beyond*

*beyond bodies, is required to be the roote and first ground of motion in them: as* Mr. White *hath most acutely and solidly demonstrated, in that excellent worke I have so often cited in my former Treatise.*

*But it is time we should fall to our intended discourse, leaving this point settled by what we have already said, that if we shew our soule, and her operations, to be not composed of parts, we also therein conclude, that she is a spirituall substance, and not a body. Which is our designe and intention in this Treatise.* Dialog. 3.°. Nodo 2 do.

*And for this intent, we must look upon those actions of men, which are peculiarly his: and upon those things which result out of them, and are called,* Opera *or* labores hominum; *as Houses, Townes, Tillage, Handicrafts, Armes, Shippes, Common-wealthes, Armies, Bookes, and the like; in which great mens lifes and thoughts have beene spent. In all these wee find one generall thred, to runne quite through them; and that all of them are composed of the same stuffe, and are built upon the same foundation: which is, a long chaine of discourses, whereof every little part or link is that which schollers do call a* Syllogisme: *and* Syllogismes *we know are framed of* enuntiations; *& they of single or uncomposed* apprehensions. *All which are actions wrought by the understanding of a man. But beyond these, we cannot proceed to any further subdivision of parts, and continue our selves within the Orbe of* humane Actions; *for simple apprehensions cannot be further resolved into other parts, beyond the degree of apprehensions, and yet still remaine actions peculiar to a man: so that wee may be sure, we shall have left nothing out of enquiry, concerning* Mans actions *as he is* Man, *if we begin with anatomizing his first bare apprehensions; and so go on by degrees, compounding them, till we come to faddome those great and admirable machines of bookes and works, which he (as I may say) weaveth*

*weaveth out of his own bowells; and the like of which, is done by no other creature whatsoever, upon the face of our contemptible Earth.*

*These then (which are all comprised under the names of* Apprehensions, *of* Enuntiations *or* Judgements, *and of* Discourses) *shall be the subject of this second Treatise: and in it, we will first consider these operations in themselves; which being done, wee will endeavour to prove out of the nature and manner of performing them, that the soules unto whom they belong, are* Immateriall *and* Immortall.

# THE SECOND TREATISE:

## DECLARING

## *The nature and operations of Mans Soule.*

### THE FIRST CHAPTER.

#### *Of simple Apprehensions.*

THat we may duly understand, what a right Apprehension is, let us consider the preeminence that a man who apprehendeth a thing rightly, hath over him who misseth of doing so. This latter can but rove wildly at the nature of the thing he apprehendeth; and will never be able to draw any operation into act, out of the apprehension he hath framed of it. As for example: if a man be to work upon gold, and by reason of its resemblance unto brasse, hath formed an apprehension of brasse, instead of an apprehension of gold, and then (knowing that the action of fire, will resolve brasse into its least parts, and sever its moist from its dry ones) will go about to calcine gold in the same manner as he would do brasse; he will soon find that he loseth his labour; and that ordinary fire is not an adequate Agent to destroy the homogeneall nature, and to sever the minute parts of that fixed mettall: all which happeneth, out of the wrong apprehension he hath made of gold. Whereas on the other side, he that apprehendeth a thing rightly, if he pleaseth to discourse of what he apprehendeth, findeth in his apprehension all the parts and qualities, which are in the thing he discourseth of: for example, if he apprehendeth rightly a knife, or a beetle, or a sive, or any other thing whatsoever; in the *knife* he will find *haft* and *blade*; the blade of iron, thick on the back, and thin on the edge; tempered to be hard and tough; thus beaten, so ground, in such manner softned, thus quenched, and whatsoever else concerneth

1. What is a right apprehension of a thing.

neth the Being or the making of a knife: and all this he draweth out of his notion or apprehenſion of a knife; which is, *that it is an inſtrument fitted to cut ſuch and ſuch things, in ſuch a manner:* for hence he findeth, that it hath an haft, fit to hold it by in ones hand, to the end it may not hurt the hand, whiles it preſſeth upon the knife; and that the blade is apt to ſlide in betwixt the parts of the thing which is to be cut, by the motion of being preſſed or drawne by the hand: and ſo he proceedeth on, deſcending to the qualities of both parts; and how they are to be joyned, and held faſt together. In the like manner, he diſcourſeth of a beetle, of a ſive, or of whatſoever elſe commeth in his way. And hee doth this, not onely in ſuch manufactures as are of mans invention; but (if he be capable) he doth the like in beaſts, in birds, in trees, in herbes, in fiſhes, in foſſiles, and in what creature ſoever he meeteth withall, within the whole extent of nature. He findeth what they are made for: and having diſcovered Natures time in their production, he can inſtruct others, what parts and manner of generation they have, or ought to have: and if he that in this manner apprehendeth any thing rightly, hath a mind to work upon it, either to make it, or to uſe and order it to ſome end of his owne; he is able by his right apprehenſion, to compare it unto other things; to prepare what is any way fitting for the making of it; to apply it unto what it will work its effect upon; and to conſerve it from what may wrong or deſtroy it: ſo, if he have framed a right apprehenſion of a ſive, he will not employ it in drawing water; if of a beetle, he will not goe about to cut with it; neither will he offer, if he have a due apprehenſion of a knife, to cut ſtone or ſteele with it, but wood, or what is ſofter. He knoweth what will whet and maintain the edge of it; and underſtandeth what will blunt or break it: In fine, he uſeth it in ſuch ſort, as the knife it ſelf (had it knowledge and will) would wiſh to be uſed; and moveth it in ſuch a manner, as if it had power of motion, it would move it ſelf: he goeth about the making it, even as nature would do, were it one of her plants: and in a word, the knife in this apprehenſion made in the man, hath thoſe cauſes, proprieties, and effects, which are naturall unto it; and which nature would give it, if it were made by her; and which are proportionable to thoſe parts, cauſes, proprieties, and effects, that nature beſtoweth on her children and creatures, according to their ſeverall eſſences.

What

What then can we imagine, but that the very nature of a thing apprehended, is truly in the man, who doth apprehend it? And that to apprehend ought, is to have the nature of that thing within ones selfe? And that man, by apprehending, doth become the thing apprehended; not by change of his nature unto it, but by assumption of it unto his?

2. The very thing it selfe is truly in his understanding who rightly apprehendeth it.

Here peradventure some will reply, that we presse our inference too far: and will peremptorily deny the things reall being in our mind, when we make a true and full apprehension of it; accounting it sufficient for our purpose, that some likenesse, or image of the thing be there; out of which, we may draw all these, whether contemplations, or workes, or disposals of the thing. But by that time this objection is throughly looked into, and that so much as they allow is duly examined, I beleeve we shall find our quarrell to be onely about the word, not about the matter: and that indeed, both of us do mean the same, howbeit diversly conceived: and that in substance their expression, in what they grant, importeth the same as ours doth: which, it is true, they first deny in words; but that may be, because the thing is not by them rightly understood.

Let us then discusse the matter particularly. What is likenesse, but an imperfect unity between a thing, and that which it is said to be like unto? If the likenesse be imperfect, it is more unlike then it is like unto it: and the liker it is, the more it is one with it; untill at length, the growing likenesse may arrive to such a perfection, and to such an unity with the thing it is like unto, that then, it shall no longer be like, but is become wholly the same, with that formerly it had but a resemblance of. For example, let us consider, in what consisteth the likenesse unto a man, of a picture drawne in black and white representing a man: and we shall find, it is onely in the proportion of the limbes and features; for the colours, the bulke, and all things else are unlike; but the proportions are the very same, in a man and in a picture; yet that picture is but a likenesse, because it wanteth cognesse and colour: give it them, and nevertheless it will bee but a likenesse, because it wanteth all the dimensions of corporeity or bulk, which are in a mans body: adde also those to it; & still it will be but a likenesse or representation of a man, because it wanteth the warmth, the softnesse, and the other qualities

of a living body, which belong to a man: but if you give it all these, then it is no longer a likenesse or image of a living creature, but a living creature indeed; and if peradventure this living creature doe continue still to be but the likenesse of a man, it is because it wanteth some perfections or proprieties belonging to a man: and so in that regard, is unlike a man: but if you allow it all those, so that in nothing it be unlike, then your taking away all unlikenesse, taketh away likenesse too: and as before of dead, it became a living creature, so now of another living creature, it becommeth a man, and is no longer like a man. You see then plainly the reason, why that, which wee call *a like thing*, is not *the same*; for in some part it is dislike: but if the likenesse were compleat in every regard, then it were no longer to be called *like*, but the very thing it selfe: and therefore wee may conclude, that if the likenesse of a thing, which the objection alloweth to be in our knowledge, doe containe all that is in the thing knowne, then it is in truth, no more a likenesse, but the very knowne thing it selfe: and so what they grant, amounteth to as much as we require; though at the first they goe about to exclude it.

3. The apprehension of things comming unto us by our senses, are resolvable into other more simple apprehensions.

Having thus concluded, that when we apprehend any thing, that very thing is in us; let us in the next place examine, how it commeth thither, and what it is there. Which we shall best doe, by anatomising, and looking narrowly into the nature of such apprehensions, as we daily make of things. It is true, we said even now, that we cannot divide the actions of mans mind, further then into apprehensions; and therefore we called them simple and uncomposed: and with good reason; for if we reflect upon the operations of our mind, we shall evidently perceive, that our bare apprehensions, and onely they, are such: but withall we must acknowledge, that all the apprehensions we make of things comming unto us by our senses, are composed of other more single apprehensions, and may be resolved into them: all which are as it were the limbs and parts, that make up and constitute the other totall one.

4. The apprehension of a *being* is the most simple and *basis* of all the rest.

Let us make use of our former example, and dissect the apprehension we make of a knife: I find in my understanding that it is a thing so long, so broad, so sharp, so heavy, of such a colour, so moulded, so tempered, &c. as is fit to cut withall. In this totall appre-

apprehenſion, I diſcover three kinds of particular apprehenſions, every one more ſimple and refined then the other. The higheſt of them, and the foundation upon which the others are built, is the notion of *Being*: which is of ſo high, and of ſo abſtracted a nature, that we cannot retrive words to expreſſe in what manner we conceive it; but are faine to content our ſelves with the outward ſound of a word, by which, without deſcribing our owne, we ſtir up the like conception in another: and that is the word *Is*; by which we intimate the *Being* of the thing we apprehend. And this notion can be in our mind, without inferring any other; and therefore is the ſimpleſt of all others: which of neceſſity, muſt imply it, and cannot be without it, although it can be without them.

5. The aprehenſion of a *thing* is in next degree to that of *Being*, and it is the *Baſis* of all the ſubſequent ones.

Our next apprehenſion is of that which hath *Being*: and is expreſſed by the word *Thing*. This is not ſo ſimple as the former; for it is compoſed of it, and of what receiveth it; of *Being*, and of *what hath Being*: yet it is much ſimpler then the next degree of apprehenſions, which is cauſed in our mind by the great variety of things, that come thither through our ſenſes; and can be conceived without any of them, though none of them can without it; for I can have in me the motion of *a thing*, abſtracting from all accidents whatſoever; as of magnitude, of figure, of colour, of reſemblance, or the like: but I cannot conceive it to be long, or ſharp, or blew, &c. without allowing it firſt to be *ſomewhat* or *ſomething*; that is in ſuch ſort affected: ſo that the apprehenſion of a *thing*, or of that which *hath Being*, is the Baſis of all our other ſubſequent apprehenſions; as the apprehenſion of *Being*, is the baſis of the apprehenſion of *a thing*: for had it not *Being*, it were not a *thing*; and were it not a *thing*, it could not be ſaid to be a *long thing* or a *ſharp thing*; nor indeed that it were *long or ſharp*: for to be ſo, doth include *Being*; and what hath *Being*, is a *Thing*. And thus we may obſerve, how the bulke of our apprehenſions is compoſed of ſomething adventitious, and of ſomething formerly within us, which is of a very different nature from all the others; and yet ſo fitted and neceſſary to them, that none of them can be without it, although it not onely can be, but is beſt conceived without relation to any of them.

6. The apprehenſion of things knowne to us by our ſenſes, doth conſiſt in certaine reſpects betwixt two things.

We ſhall eaſily diſcerne, of how different a ſtraine this conception of *Being*, is from all others, that enter by our ſenſes, (as from the

the conceptions of colours, of ſounds, and the like) if wee but reflect upon that act in us, which maketh it; and then compare it with the others: for we ſhall find, that all they do conſiſt *in*, or *of* certain reſpects betwixt two things; whereas this of *Being*, is an abſolute and ſimple conception of it ſelf, without any relation to ought it elſe; and cannot be deſcribed or expreſſed with other words, or by comparing it to any other thing: only wee are ſure, we underſtand and know what it is.

But to make this point the clearer, it will not be amiſſe, to ſhew more particularly, wherin the other ſorts of apprehenſions are different from this of *Being*; and how they conſiſt in certaine reſpects between different things, and are knowne only by thoſe reſpects: whereas this knowne only in it ſelf; abſtracting from all other things whatſoever. An example will doe it beſt: when I apprehend the *whiteneſſe* in the wall, I may conſider how that white, is a thing which maketh ſuch an impreſſion upon my fantaſy; and ſo accordingly, I know or expreſſe the nature of *white*, by a reſpect or proportion of the wall, to work upon my fantaſy. In like maner, if we take a notion that ariſeth out of what entreth immediately by our ſenſes, (for by joyning ſuch alſo to the notion of *Being*, we make ordinary apprehenſions) we ſhall find the ſame nature: as when I conſider how this white wall, is *like* to another white wall, the apprehenſion of *likeneſſe* that I have in my mind, is nothing elſe, but a notion ariſing out of the impreſſion, which both thoſe walles together, do make upon my fantaſy; ſo that, this apprehenſion is as the former, a certain kind of reſpect or proportion of the two walles to my imagination: not as they make their impreſſions immediately upon it, but as another notion ariſeth, out of comparing the ſeverall impreſſions, which thoſe two white walles made in it.

7. Reſpect or relation hath not really any formall being, but only in the apprehenſion of man.

Let us proceed a little further, and examine what kind of thing that is, which we call *reſpect* or *proportion*, and where it reſideth. We ſhal find, that there is a very great difference, between what it is in it ſelfe, or in its owne eſſence, and what it is in the things that are reſpective: for in them, it is nothing elſe but the things, being plainly and bluntly what they are really in themſelves: as for example, two white walls to be like, is in them nothing elſe, but each of them to be white: and two quantities to be halfe and whole, is in thē nothing elſe, but each quantity to be juſt what it is.

But

But a *respect* in its owne nature, is a kind of tye, comparison, tending, or order, of one of those things to another; and is no where to be found in its formall subsistence, but in the apprehension of man: and therefore it cannot be described by any similitude, nor be expressed by any means, but (like *Being*) by the sound of a word, which we are agreed upon to stirre up in us such a notion; for in the things, it is not such a thing as our notion of it is: (which notion is that, which we use to expresse by Propositions and conjunctions, and which Aristotle and Logicians expresse in common, by the word πρός, or *ad*) and therefore there is nothing out of us, to paint it by: as I could doe *white* or *square*, or *round*, or the like; because these have a being in the things that are white, or square, &c. and consequently they may be expressed by others of the like nature: but the *likenesse* that one white hath to another, or the *respect* that either of them hath to mans imagination, is only in Man; who by comparing them, giveth birth to the nature and Being of *respect*.

Out of this discourse, we may collect two singularities of man; which will much import us, to take particular notice of: the one is, that *Being* or a *thing* (the formall notion of which is meerly *Being*) is the proper affection of man; for every particular thing is in him, by being (as I may say) grafted upon the stocke of *Existence* or of *Being*: and accordingly we see, that whatsoever we speak of, we say it is *something*: and whatsoever wee conceive, we give it the nature of a *thing*; as when we have said, the wall is white, we frame *whitenesse* as *a thing*: so did we immediately before speaking of *Respect*, we took *respect* as it were a *thing* and enquired, *where* it is: so that it is evident, that all the negotiation of our understanding, tradeth in all that is apprehended by it, as if they were *things*.

8. That *Existence* or *being* is the proper affection of man: and that mans soule is a comparing power.

The other singularity we may observe in man is, that he is a *comparing power*; for all his particular knowledges, are nothing else but *respects* or *comparisons* betweene particular things: as for example, for a man to know heat, or cold, &c. is to know, what effects fire or water, &c. can worke upon such or such bodies.

9. A thing by comming into the understanding of man, looseth nothing of its owne peculiar nature.

Out of the first of these proprieties it followeth, that what affecteth a man, or maketh impression upon his understanding, doth not ethereby loose its owne peculiar nature, nor is it modified to the recipient; the contrary of which, wee see happeneth perpetually

petually in bodies: obſerve the ſuſtenance we take; which that it may be once part of our body, is firſt changed into a ſubſtance like our body, and ceaſeth being what it was: when water or any liquid body is received into a veſſell, it looſeth its owne figure, and putteth on the figure of the veſſell it is in: if heat entreth into a body that is already hot, that heat becommeth thereby more heat; if into a cold body, it is converted into warmth: & in like manner, all other corporeall things are accommodated to the qualities of the recipient; and in it, they looſe their owne proper termes and conſiſtences: but what commeth into the underſtanding of a man, is in ſuch ſort received by him or joyned to him, that it ſtill retaineth its own proper limitations and particular nature; notwithſtanding the aſſumption of it unto him: for *Being* is joyned to every thing there; ſince (as we have ſaid) it is by *Being* that any thing commeth thither: and conſequently this ſtock of *Being*, maketh every graft that is inoculated into it, *Be* what of its own nature it is; for *Being* joyned to another notion, doth not change that notion, but maketh it be what it was before; ſithence if it ſhould be changed, *Being* were not added to it: as for example, adde *Being* to the notion of *knife*, and it maketh a *knife*, or that notion, to *Be* a *knife*: and if after the addition, it doth not remaine a *knife* it was not *Being*, that was added to a *knife*.

10. A multitude of things may bee united in mans underſtanding without being mingled or confounded together.

Out of the later of the ſingularities proper to man, it followeth, that multitude of things may be united in him, without ſuffering any confuſion among themſelves; but every one of them, will remaine with its proprieties, and diſtinct limitations: for ſo of neceſſity it muſt be, when that which uniteth them to him, is the comparing of them to ſomething beſides themſelves: which work could not be performed, unleſſe what is to be compared, doe retaine exactly its owne nature, whereby the compariſon may bee made: no more then one can weigh two quantities one againſt another, unleſſe he keep aſunder what is in each ſcale, and keep all other weights from mingling with them: and accordingly we ſee that we cannot compare black to white, or a horſe to an oxe, unleſſe we take together, the properties by which black differeth from white, or an oxe from a horſe: and conſequently, they muſt remaine unmingled and without confuſion, preciſely what in themſelves they are, and be different in the ſight of the comparer.

But

But indeed, if we look well into the matter, we shall find, that setting aside the notion of *Existence* or of *Being*, all our other notions are nothing else, but *comparisons* and *respects*: and that by the mediation of *respects*, the natures of all things are in us: and that by the varying of them, we multiply our notions: which in their first division, that reduceth their severall kinds into generall heads, doe increase into the ten famous tribes, that Logicians call *Predicaments*: and they doe comprehend under them, all the particular notions that man hath, or can have, according to the course of knowledge in this life. Of which *Predicaments* the seven last are so manifestly respective, that all men acknowledge them to be so. *Substance* we have already shewed to have a respect unto *Being*, *Quantity* we proved in the first Chapter of the former Treatise of the nature and of the operation of Bodies, to consist in a respect unto parts. *Quality* is divided into foure branches: whereof *Power* is clearely a respect to that over which it hath power, or from which it may suffer. *Habite* is a respect to the substance wherein it is; as being the property by which it is well or ill, conveniently or inconveniently affected, in regard of its owne nature; as you may observe in health, or sicknesse, or the like. The *passible Qualities* are those which we have explicated, in discoursing of the Elements and of Mixts; and whose natures we have there shewed do consist in respects of acting or of suffering. *Figure* or *shape* (which is the last branch of the division of the Predicament of Quality) is nothing else, but a certain disposition of one part of a body to another. And so you see, how all the ten *Predicaments* doe consist purely in diversity of *Respects*: and by consequence, all our conceits and notions (excepting that of *Being*, which is the stock, upon which all the rest are grafted) are nothing else, but various respects; since all of them whatsoever, are comprised under those generall heads. Concerning which, wee shall not need to dilate our selves any further; seeing they are to be found in *Aristotle*, and in his Commentators, largely discoursed of.

II. Of abstracted and concrete termes.

In the next place, let us observe, how our understanding behaveth it selfe, in considering and in apprehending these respects. We have already declared, that the variety of our notions, doth arise out of the respects which diverse things have to one another: hence will follow, that of the same thing, wee may have various notions

notions: for comparing it to different things, we ſhall meet with different reſpects between them; and conſequently, we ſhal conſider the ſame thing, under different notions: as when we conſider an apple, under the notions of greenneſſe, of ſweetneſſe, of roundneſſe: of mellowneſſe, &c. in ſuch ſort, as we have amply declared in the firſt Treatiſe, and therefore need not here enlarge our ſelves any further upon this particular. Now theſe notions are ſo obſolutely ſevered one from another, and every one of them hath ſuch a compleatneſſe within it ſelfe, that we may uſe any one of them, without medling at all with any of the others. And this we doe two ſeverall wayes: the one, when our manner of apprehenſion determineth us to one preciſe notion, which is ſo ſummed up within it ſelfe, as it not onely abſtracteth from all other notions, but alſo quite excludeth them, and admitteth no ſociety with them. The other way is, when we conſider a thing under a determinate notion, yet we doe it in ſuch a manner, that although we abſtract from all other notions, nevertheleſſe we doe ſo, rather by neglecting then by excluding them: and even in the manner of our expreſſion of it, we inſinuate that there are other notions (without ſpecifying what) belonging unto it.

Of the firſt kind of notions, are whiteneſſe, weight, heat, and ſuch like, (whoſe names are called *abſtracted termes*) which although they ariſe out of our comparing of the things that are white, heavy, hot, &c. to our fantaſie, or to other things; yet theſe notions are ſo preciſe, and ſhut up within themſelves, that they abſolutely exclude all others, (as of long, ſhort, ſquare, rough, ſharp, or whatſoever elſe) which may in the things accompany the whiteneſſe, weight, heat, &c. that our conſideration is then buſied only withall. Of the ſecond kind of abſtracted notions, are white, heavy, hot, &c. (whoſe names, expreſſing them, are called *concrete termes:*) which although they cauſe in us no other apprehenſions then of whiteneſſe, of weight, of heat, &c. yet they are not ſo rigorouſly paled in, as the others are, from admitting ſociety with any beſides; but doe imply tacitely, that the thing which is white, heavy, hot, &c. hath beſides that, ſome other conſideration belonging unto it (whatſoever it be) which is not expreſſed.

Now in this later abſtraction, it happeneth ſometimes, that the

the notion expreſſed, hath but an accidentall connexion with the other notions, that are in the thing unexpreſſed: as for example; it is meerely accidentall to the white wall as it is *white*, to be high or low, of ſtone, of plaſter, or the like. But otherwhiles, the expreſſed notion is ſo eſſentiall to the concealed ones, that they cannot be without it: as when we apprehend a cloven foot, although this apprehenſion doe abſtract from all other notions beſides *clovenfootedneſſe* (if ſo I may ſay) yet, (as above we have declared) it is in ſuch a manner, that it implyeth other conſiderations, not yet expreſſed, in that cloven foot: among which, ſome may be of that nature, that they cannot have a Being without preſuppoſing clovenfootedneſſe; but others may be meerly accidentall to that notion: as (for inſtance ſake) let one be, *that the foot is cloven into three parts*; and let another be, *that it is black or hairie*; of theſe, this later notion of *black or hairie*, is of the firſt kind of abſtractions, which we ſaid had but an accidentall connexion with that which comprehended them without expreſſing them: for other things beſides the cloven foot, may be black or hairie; in ſuch ſort as height or lowneſſe, to be of ſtone or of plaſter, may belong unto other ſtractures beſides the white wall: but to be *cloven footed into three parts*, doth ſo neceſſarily depend of being cloven footed in generall, (which implyeth this particular) and ſo directly includeth it, as it cannot ſubſiſt without *clovenfootedneſſe*: for though we may conceive a foot to be cloven, without determining in our apprehenſion, into how many toes it is cloven; yet we cannot conceive it to have three, foure, or five toes, without apprehending it to be cloven: ſo that in ſuch like apprehenſions, the notion which is expreſſed, is ſo eſſentiall to the notion that is concealed and added unto it, as the concealed one cannot be conceived without the expreſſed one; and whenſoever it is mentioned, the other is neceſſarily alſo brought in, and affirmed with it.

12. Of univerſall notions.

Now, ſome of theſe later kinds of notions, (in which what is expreſſed is eſſential to what is concealed) may be of ſuch a nature as to be capable of receiving the addition of ſundry other notions, ſo repugnant unto one another, that they cannot agree together in one ſubject; & yet that generall notion, without determining any of the others, be indifferent to the contrary additions that include it, and belong as much to any one, as to any other of them: and

ſo

ſo conſequently, whatſoever may be affirmed, and is true, of the primary notion, may as well be affirmed, and is as true, of the ſeverall particulars, ariſing out of the repugnant additions. Such a notion, Logitians terme an *Vniverſall* one: that is, one that reacheth indifferently and equally to all the particulars compriſed under it. As for example: to the notion of a living creature, may be added the notions of *Reaſonable* and *unreaſonable*: which firſt notion, when it is barely expreſſed, it determineth no one of the two ſecondary notions, more then it doth the other: but is alike indifferent to either; and whatſoever belongeth to a living creature, belongeth entirely both to a man and to a beaſt: yet no one thing, can be both *reaſonable* and *unreaſonable*. In like manner when I ſay, *a man is a diſcurſive creature*; under this word *man*, there lyeth a notion, by which may be ſignifyed any particular man, as *Thomas*, *Iohn*, *William*, &c. though of it ſelfe, it determine no one man whatſoever: and conſequently, every one of theſe particular men, muſt be allowed to be a diſcurſive creature, becauſe the being ſuch, belongeth unto the notion of *man*, and that notion unto all the particulars of *Thomas*, *Iohn*, *William*, &c. and yet no particular man can be both *Thomas* and *Iohn*, or *Iohn* and *William*, &c.

In this kind of notion, we may obſerve yet one propriety more: which is, that of it ſelfe, and in its common terme, it doth not cauſe ones thought to range unto ſeveral objects; nor doth it imply that there are many particulars compriſed under it: yet if there be never ſo many, that conceit will fit them every one; and if there be but one, ſtill it will be no leſſe accommodated to that one. As for example: He that maketh a right apprehenſion of a *ſunne*, doth not by that conception determine, whether there be many ſuns or but one: and if every one of the ſtars (which we call fixed) be ſuns to other earths, it fitteth them all; and if there be no other ſunne, then that which ſhineth to us, it is ſatisfyed and taken up with that: ſo likewiſe, before the production of *Eve*, the notion of a man was as fully taken up by *Adam* alone, as it is now by his numerous progenie that filleth the world: nor doth our underſtanding, when that terme is pronounced, conſider (out of the force of the terme) whether there be many men, or onely one.

13. Of apprehending a multitude under one notion.

Another proprity in mans apprehenſion not much unlike

to

to this, is, that he is able to compriſe a multitude in one indiviſible notion; and yet, that notion expreſſe the multiplicity of what it containeth: as we ſee in numbers, where the indiviſible conception of *ten*, *a hundred*, *a thouſand*, &c. doth plainly expreſſe the ſubject to be many; and yet that notion of the number bindeth them up (as I may ſay) into one bundle, that in it ſelfe admitteth no diviſion, nor will permit that the leaſt part be taken from it; for if it be, the whole bundle is deſtroyed and vaniſheth: as when I take *ten*, if one be diminiſhed from it, it is no longer *ten*, but *nine*. It fareth in like manner with the conceptions we frame of *All*, and *Every one*, as it doth with numbers; for if but one be deficient, it is but a part, and not *all*, or *every one*: ſo that theſe notions doe inviſibly terminate a multitude. And like to this notion, is the name or terme *whole*, in reſpect of things which as yet have not diviſion, but are capable of being divided; for it is ſo rigorous, that if the leaſt atome or thought be wanting, it is no longer the *whole*, but onely a part.

14. The power of the underſtanding reacheth as far as the extent of *being*.

And this is as much as at preſent appeareth unto me needfull to be ſaid, concerning ſingle apprehenſions: unleſſe I be permitted to adde for a concluſion, this little note, (which peradventure might have been more properly ſet downe in another place, where we diſcourſed of *Being*, but that it occurred not then to me) that apprehenſion being rooted in the nature of *Being*, the power of it ſpreadeth it ſelfe as farre as the extent of *Being*: and conſequently reacheth to all things whatſoever; for whatſoever is a *thing*, hath *Being*; and that unto which *Being* doth not reach, is nothing. Nay, it is not limited there, but graſpeth even at *nothing*, and aymeth to make a notion of it, and planteth its generation, by multiplying it ſelfe by negations of whatſoever is. Hence we have the notions of deafneſſe, of dumbneſſe, of blindneſſe, of lameneſſe, of baldneſſe, of death, of ſinne, and of all evils whatſoever, by the want of ſuch goods, as are ſenſible unto us.

THE

## THE SECOND CHAPTER.

### *Of Thinking and Knowing.*

1. How a judgement is made by the understanding.

HAving thus declared the nature of ſingle apprehenſions, the method we have preſcribed our ſelves, requireth that wee examine in the next place, what effect the joyning of them together may have; for from thence doe ſpring *Enunciations* or *Iudgements*; which are in the next rank after ſimple apprehenſions, and are the materials whereof *diſcourſes* are immediately framed: as when of the two apprehenſions of *knife* and of *ſharpe*, we may make this enunciation, *the knife is ſharpe*. In this enquiry the firſt thing that occurreth unto us, is to conſider, in what manner two differing ſimple apprehenſions, doe become joyned to one another: and we ſhall find, that they are not tyed together like ſeverall diſtinct things in one bundle, or like ſtones in a heap, where all that are compriſed under one multitude, are yet circumſcribed within their owne limits, and thereby are wholly diſtinguiſhed from each other; but that they are as it were grafted upon one ſtock; which being common to both, giveth the ſame life to both; and ſo becomming one with each of them, maketh them be one and the ſame thing between themſelves. And this is the notion of *Being* or *Exiſtence*, in the ſubject we ſpeak of: which (as we have already ſhewed) is the Baſis and foundation of all other apprehenſions; and by being common and indifferent to all, is the fitteſt glew to unite thoſe that are capable of ſuch conjunction: and accordingly we ſee, that moſt of our ſpeech runneth upon this ſtraine, that *this is that*, or *doth that*, (which is as much to ſay as *is doing that*) that *Socrates is a man*, or that *Socrates runneth*, (which ſignifyeth, *is running*) and the like: and ſince our ſpeech proceedeth from the conceptions of our mind; it is cleare, that as the words which expreſſe *Being* or *Exiſtence*, doe joyne together the other words that we uſe, (or at leaſt, the greateſt part of them) ſo likewiſe in our mind the apprehenſion of *Being*, is the glew that joyneth our apprehenſions correſponding to our words.

All which will appeare to be ſaid with great reaſon, if we reflect upon it; for when diverſe apprehenſions may be thus joyned together, it is indeed, that one and the ſame thing affecting us ſeverall

verall wayes and under different considerations; those indifferent expressions doe beget different apprehensions in us: and so, till we examine the matter, every one of them seemeth to be a different thing: but when we trace these streames up to the fountaine head, we discerne that all of them doe belong to one and the same thing; and that by being in that thing, they are among themselves the very same thing, however they affect us variously; and therefore may truly be said to be one, as indeed they are: and consequently, nothing is more fit to joyne together in our mind those different apprehensions, then the apprehension of *Being*; which maketh us apprehend as one thing, those notions which really, and in the thing it selfe, are but one, as we have often touched, both in the former Treatise, and lately in this: for this is the way to joyne things in the mind intelligently, and according to the proper nature of the mind; which receiving impressions from things existent, ought to consider those impressions as they flow from the very things, and not as they are in the mind it selfe; and by mediation of those impressions, must take a survey of the things themselves; and not stay at the intellectuall impressions they make in her: and consequently, must apprehend those things to be one in themselves, (although in us they be not so) according to the course of our originall and legitimate apprehensions of things; which is, as they are existent; that is, as they are in their owne nature, and in themselves; and not according to the discourses and secondary apprehensions we make of the images we find of them in our mind. And thus things are rightly joyned by apprehension; without caution in which particular, we shall run into great errors in our discourse: for if we be not very carefull herein, we are apt to mistake the use of the impressions we receive from things, and to ground our judgements concerning them, according to what we find of them in our mind, and not according to what they are in themselves: which two severall considerations, have quite different faces; although (it is true) those impressions are made by the things, and are the onely meanes by which we may rightly judge of them: provided, that we consider them as they are in the things, and not as they are in us.

Now this conjunction of apprehensions, by the mediation and the glew of *Being*, is the most naturall and fitting, not onely in regard

regard of the things, but even in regard of us: for (as we have already shewed) it is of all others the most common and universall, the most simple or uncompoſed, and the most naturall and deepeſt rooted in man: out of all which, it is evident, that this union of apprehenſions by the meanes of *Being*, is in truth an Identification of them: for Unity being a negation of multiplicity, it followeth, that what is one, is the ſame: and this identification is truly and naturally expreſſed by ſaying, that *the one is the other*.

3. How the notions of a ſubſtantive and an adjective, are united in the ſoule, by the common ſtock of *being*.

But inſiſting a little further upon this conſideration, how different apprehenſions become joyned and united together, by the notion of *Being*; we may obſerve that this happeneth, not onely to two ſingle ones, but to more; according as more then two, may belong unto one thing: and it may ſo fall out, that more then one, be on either ſide the common ligament. Thus when we ſay, *A Man is a diſcourſive creature*; or *a Rationall ſoule, is an immortall ſubſtance*, the two apprehenſions, of *diſcourſive*, and of *creature*, are joyned together in a third of *Man*, by the tye of one *Being*: and the two apprehenſions of *Immortall*, and of *Subſtance*, are united to the two others of *Rationall* and of *Soule*, likewiſe by the ligament of one ſingle *Being*. Evident it is then, that the extremes are united by one *Being*: but how the two apprehenſions that are ranked together on the ſame ſide of the ligament (as in our former examples, the apprehenſions of *diſcourſive* and of *creature*, of *Rationall* and of *Soule*, of *Immortall* and of *Subſtance*) are betweene themſelves joyned to one another, is not ſo eaſie to expreſſe. It is cleere, that it is not done by meere conglobation; for we may obſerve, that they doe belong, or are apprehended to belong, unto the ſame thing; and the very words that expreſſe them, doe intimate ſo much, by one of them being an adjective; which ſheweth, they are not two things; for if they were, they would require two ſubſtantives to deſcribe them: and conſequently it followeth that one of them muſt needs appertaine to the other: and ſo both of them make but one thing.

And there is no doubt, but in the inward apprehenſion, there is a variety correſpondent to the variety of words which expreſſe it; ſince all variety of words that is made by intention, reſulteth out of ſome ſuch variety of apprehenſions. Therefore, ſince the words doe import, that the things have a dependance the one of the

the other, we cannot doubt, but that our apprehenſions have ſo too: which will be conceived beſt, by looking into the act of our mind, when it frameth ſuch variety of apprehenſions belonging to one thing, correſpondent to the variety in words of an *adjective* glewed unto his *ſubſtantive*; and attending heedfully to what we meane, when we ſpeak ſo. The Hebrewes doe expreſſe this union, or compriſing of two different apprehenſions under one notion, by putting in the genetive caſe, the word which expreſſeth one of them, (much like the rule in *Lillies* Grammar, that when two ſubſtantives come together, if they belong to the ſame thing, the one is put in the genetive caſe.) As when in the Scripture we meet with theſe words, *the judge of unjuſtice*, *the ſpence of wickedneſſe*, *the man of ſinne*, or *of death*; which in our phraſe of ſpeaking, doe ſignify an unjuſt judge, a wicked ſpence, and a ſinfull or dead man. In which it is evident, that as well the manner of underſtanding, as of ſpeaking, taketh each paire of theſe notions to belong unto one thing; that is, to have both of them, one and the ſame *Exiſtence*, although there intervene not the formall expreſſion of their being one. Thus we ſee, how one *Being* ſerveth two different wayes to joyne and unite ſeverall apprehenſions: and if we will examine all the negotiations of our underſtanding, we ſhall hardly find any notions ſo farre diſtant, but may be brought together, either by the one of theſe wayes, or by the other.

4. That a ſetled judgement becometh a part of our ſoule.

But this compoſition and joyning of ſeverall apprehenſions by the glew of *Being*, is not ſufficient to make us deem a thing to be really ſuch, as their union painteth in the mind, or as the words ſo tyed together doe expreſſe in ſpeech. Well may it cauſe us to think of the thing; but to think, or to deem it ſuch an one (which word of *deeming*, we ſhall bee obliged henceforward to uſe frequently, becauſe the word *thinking* is ſubject to equivocation) requireth the addition of ſomething more, then barely this compoſition of apprehenſions; which unleſſe they be kept ſtraight by ſome levell, may as well ſwarve from the ſubject, as make a true picture of it. Here then we are to examine, what it is that maketh us thinke any thing to be ſuch as wee apprehend it: this wee are ſure of, that when we doe ſo, our actions which proceed upon reaſon, and which have relation to that thing, are governed and ſteered in every circumſtance, juſt as the thing were truly ſo:

as for example, if a man doe really deem the weather to be cold, or that his body is distempered, he putteth on warmer cloathes, or taketh physick; although peradventure he is mistaken in both: for his deeming them to be so, maketh him demeane himselfe in such sort, as if really they were so. It is then evident, that by such thinking or deeming, the nature conceived, is made an active principle in us: unto which if we adde, that all the knowledge we have of our soule, is no more, but that it is an *active force* in us, it seemeth, that a thing, by having apprehensions made of it in our mind, and by being really thought to be agreeable to such apprehensions, becometh (as it were) a part or affection of our soule, and one thing with it. And this peradventure is the cause; why an understanding man cannot easily leave an opinion once deeply rooted in him; but doth wrestle and strive against all arguments that would force him from it, as if a part of his soule or understanding were to be torne from him: in such manner as a beast will cry and struggle to save his body, from having any of his limbes disjoynted or pulled in peices.

5. How the soule commeth to deem or settle a judgement.

But this observing the effect which followeth of our deeming a thing to be thus or so, is not sufficient to informe us, what it is that causeth that deeming. We must therefore take the matter a little higher, and look into its immediate principles: and there we shall find, that it is the knowing of what we say to be true, and the assurance, that the things are as wee deem them, which quieteth our soule, and maketh it consent unto them, and proceed to action upon that consent. Now this knowledge, is the most eminent part of deeming; and of all our acquisitions, is the most inseparable from us: and indeed in rigour, it is absolutely inseparable by direct meanes; however peradventure by indirect meanes it may be separated.

Let us then consider how wee attaine unto it, and how sometimes wee faile in the purchase of it; and what degrees of assurance or of probability there are between it and errour. To this intent, wee may observe that the greatest assurance, and the most eminent knowledge wee can have of any thing, is of such Propositions, as in the Schooles are called *Identicall*; as if one should say, *Iohn is Iohn*, or *a man is a man*: for the truth of these Propositions is so evident and cleare, as it is impossible any man should doubt of them, if hee understand what he

hee ſaith: and if wee ſhould meet with one that were not ſatisfied of the verity of them, wee would not goe about to prove them to him, but would onely apply our ſelves to make him reflect upon the words hee ſpeaketh, without uſing any further induſtry to gaine his aſſent thereunto: which is a manifeſt ſigne, that in ſuch Propoſitions, the apprehending or underſtanding them, is the ſame thing as to know them and to conſent unto them: or at the leaſt, that they are ſo neceſſarily conjoyned, as the one followeth immediately out of the other, without needing any other cauſes to promote this effect, more then that a man be diſpoſed, and willing to ſee the truth: ſo as wee may conclude, that to underſtand a Propoſition which onely carrieth its evidence with it, is to know it. And by the ſame reaſon, although the evidence of a Propoſition, ſhould not at the firſt ſight bee preſently obvious unto us, yet with unfolding and explicating of it, wee come at length to diſcerne it; then likewiſe the apprehending of it, is the knowing of it.

We muſt therefore enquire, what it is that cauſeth this evidence: and to that purpoſe, reflecting upon thoſe inſtances wee have given of *Identicall Propoſitions*, we may in them obſerve, that evidence ariſeth out of the plaine Identification of the extreames that are affirmed of one another; ſo that, in what Propoſition ſoever, the Identification of the extreames is plaine, the truth of it is evident unto us, and our mind is ſatisfied and at quiet; as being aſſured that it knoweth it to be ſo as the words ſay it. Now all affirmative Propoſitions doe by the forme of them import an Identification of their extreames, (for they all agree in ſaying *This is that*) yet they are not all alike in the evidence of their Identification: for in ſome it ſheweth it ſelfe plainly, without needing any further help to diſcover it; and thoſe are without any more adoe knowne of themſelves, as ſuch *Identicall* ſayings, wee even now gave for examples: others require a journey ſomewhat further about to ſhew their Identification; which if it bee not ſo hidden, but that it may in the end bee diſcovered and brought to light, as ſoon as that is done, the knowledge ſetled by them in the ſoule, is certaine and ſatisfactory as well as the other: but if it be ſo obſcure, that we cannot diſplay the Identification of it, then our mind ſuſpendeth his aſſent, and is

unquiet about it, and doubteth of the truth of it: in ſome Propoſitions, whiles he ſearcheth and enquireth after the Identification of their extreames; peradventure he diſcerneth, that it is impoſſible there ſhould be any between them; and then on the other ſide, he is ſatisfyed of the falſity of them: for if a Propoſition be affirmative, it muſt neceſſarily be a falſe one, if there bee no Identification between the extreames of it.

By this diſcourſe, wee have found two ſorts of Propoſitions, which beget knowledge in us. The one, where the Identification of the extreames, is of it ſelfe ſo manifeſt, that when they are but explicated, it needeth no further proofe. The other, where though in truth they be Identifyed, yet the Identification appeareth not ſo cleare, but that ſome diſcourſe is required to ſatisfy the underſtanding therein. Of the firſt kind, are ſuch Propoſitions as doe make one of the extreams the definition of the other whereof it is affirmed: as when wee ſay, *a man is a reaſonable creature*; which is ſo evident, if we underſtand what is meaned by *Man*, and what by *a reaſonable creature*, as it needeth no further proofe to make us know it: and knowledge is begotten in us, not only by a perfect Identification of the extreames, but as well by an imperfect one: as when what is ſaid of another, is but part of its definition; for example, if one ſhould ſay, *a man is a creature*, no body that knoweth him to bee a rationall creature, (which is his compleat definition) could doubt of his being a creature; becauſe that the being *a creature*, is partly identifyed to being *a rationall creature*. In like manner, this obvious evidence of *Identification*, appeareth as well where a compleat diviſion of a thing is affirmed of the other extreame, as where that affirmation is made by the totall or partiall definition of it: as when we ſay, number is even or odde: an enuntiation is true or falſe, and the like: where, becauſe what is ſaid, compriſeth the differences of the thing whereof it is ſaid, it is plaine that of them muſt needes bee that whereof wee ſpeak.

Peradventure ſome may expect, that we ſhould give *Identicall Propoſitions* (among others) for examples of this plaine evidence: but becauſe they bring no acquiſition of new knowledge unto the ſoule, (the doing of which, and the reflecting upon the manner, is the ſcope of this Chapter) I let them paſſe with-

out

out any further mention, upon this occasion having produced them once before, onely to shew by an undeniable example, what it it is that maketh our soule consent unto an enunciation, and how knowledge is begotten in her, that we might afterwards apply the force of it to other Propositions.

Let us therefore proceed to the second sort of Propositions, which require some discourse, to prove the Identification of their extreames. Now the scope of such discourse is, by comparing them unto some other third thing, to shew their Identification between themselves; for it sheweth, that each of them apart is identified with that new subject it bringeth in: and then our understanding is satisfied of their identity, and our soule is secure of that knowledge it thus acquireth, as well as it is of that which resulteth out of those Propositions, which beare their evidence in their first aspect.

This negotiation of the understanding to discover the truth of Propositions, when it is somewhat hidden, (which we call *discourse*) as it is one of the chiefest and noblest actions of the soule, so doth it challenge a very heedfull inspection into it: and therefore we will allow it a peculiar Chapter by it selfe, to explicate the nature and particularities of it. But this little wee now have said concerning it, is sufficient for this place; where all we ayme at is to prove (and I conceive we have done it very fully) that when *Identity* between two or more things, presenteth it selfe to our understanding, it maketh and forceth knowledge in our soule.

Whence it is manifest, that the same power or soule, which in a single apprehension is possessed with the *Entity* or *Vnity* of it, is that very power or soul, which applyed to an *Enunciation*, knoweth or deemeth; since *knowing* is nothing else, but the apprehending of manifest Identity in the extremes of a Proposition, or an effect immediately consequent out of it, in the soule that applyeth it selfe to apprehend that Identity. Which apprehension is made, either by the force of the extremes, applyed immediately to one another, or else by the application of them to some other thing: which peradventure may require yet a further application unto new apprehensions, to make the Identity between the first extremes appeare evidently.

6. How opinion is begotten in the understanding.

Now, as when *Identity* truly appeareth, it maketh evidence to our understanding, and begetteth assured knowledge in our

ſoule; ſo, when there is onely an apparent Identity, but not a reall one, it happeneth that the underſtanding is quieted without evidence; and our ſoule is fraught with a wrong or ſlight beliefe, inſtead of certaine knowledge: As for example, it is for the moſt part true, that what wiſe men affirme, is ſo as they ſay; but becauſe wiſe men are but men (and conſequently not infallible) it may happen that in ſome one thing, the wiſeſt men that are may miſſe, though in moſt and generally ſpeaking, they hit right. Now if any body in a particular occaſion, ſhould (without examining the matter) take this propoſition rigorouſly and peremptorily, *that what wiſe men affirme is true*; and ſhould thereupon ſubſume with evidence, *that wiſe men ſay ſuch a particular thing*, and ſhould thereupon proceed to beleeve it; in this caſe he may be deceived, becauſe the firſt propoſition is not verily, but onely ſeemingly evident.

And this is the manner how that kind of deeming, which is either oppoſed, or inferiour to knowledge, is bred in us: to wit, when either through temerity, in ſuch caſes where we may, and it is juſt we ſhould examine all particulars ſo carefully, that no equivocation or miſtake in any part of them, be admitted to paſſe upon us for a truth, and yet we doe not: or elſe, through the limitedneſſe and imperfection of our nature, when the minuteneſſe and variety of petty circumſtances in a buſineſſe is ſuch, as we cannot enter into an exact examination of all that belongeth to that matter, (for if we ſhould exactly diſcuſſe every ſlight particular, we ſhould never get through any thing of moment) we ſettle our underſtanding upon grounds that are not ſufficient to move and determine it. Now in ſome of theſe caſes, (and particularly in the latter) it may happen, that the underſtanding it ſelf is aware, that it neither hath diſcovered, nor can diſcover evidence enough, to ſettle its aſſent with abſolute aſſurance: and then it judgeth the beliefe it affordeth unto ſuch a propoſition, to be but probable; and inſtead of knowledge, hath but *opinion* concerning it. Which *opinion* appeareth to it more or leſſe probable, according as the motives it relyeth on, are ſtronger or weaker.

7. How faith is begotten in the underſtanding.

There remaineth yet another kind of deeming for us to ſpeake of; which though it ever faile of evidence, yet ſometimes it is better then opinion, for ſometimes it bringeth certitude with it. This we call *Faith*; and it is bred in this ſort: when we meet with

with a man, who knoweth ſomething which we doe not, if withall we be perſwaded that he doth not, nor will not tell a lye; we then beleeve what he ſaith of that thing to be true: now according to the perſwaſion we have of his knowledge and veracity, our beliefe is ſtrong, or mingled with doubt: ſo that if we have abſolute aſſurance and certainty, that he knoweth the truth and will not lye, then we may be aſſured, that the faith which wee yeeld to what he ſaith, is certaine as well as evident knowledge is certaine, and admitteth no compariſon with opinion, be it never ſo probable: but ſo it may happen, that we may be certainly aſſured that a man doth know the truth of what he ſpeaketh of, and that he will not lye in reporting it to us: for ſeeing no man is wicked without a cauſe; and that to tell a lye in a ſerious matter, is a great wickedneſſe; if once we come to be certaine that he hath no cauſe, (as it may fall out we may) then it followeth, that we are aſſured of the thing which he reporteth to us.

Yet ſtill ſuch faith falleth ſhort of the evidence of knowledge in this regard, that its evidence ſticketh one degree on this ſide the thing it ſelfe: and at the puſh, in ſuch a caſe we ſee but with anothers eyes; and conſequently, if any oppoſition doe ariſe againſt our thought thereabout, it is not the beames, and the light of the thing it ſelfe, which ſtrengthen us againſt ſuch oppoſition, but the goodneſſe of the party upon whom we rely.

8. Why truth is the perfection of a reaſonable ſoule: and why it is not found in ſimple apprehenſions as well as in Enuntiations.

Before I goe any further, I muſt needs remember one thing, that our Maſters teach us: which is, that truth and falſehood are firſt found in ſayings or *Enuntiations*; and that although ſingle apprehenſions are in our mind before theſe judgements, yet are they not true or falſe themſelves, nor is the underſtanding ſo by them. To comprehend the reaſon of this maxime, let us conſider what truth and falſehood are: ſurely truth is nothing elſe, but the confirmity of our underſtanding, with the things that make impreſſion upon it: and conſequently, falſehood is a diſagreeing between our mind and thoſe things: if the exiſtence which the things have in us, be agreeable to the Exiſtence they have in themſelves; then our underſtanding is true; otherwiſe it is falſe. Now the naturall perfection of our Soule or underſtanding, is to be fraught with the reſt of the whole world, that is to have the knowledge of all things that are; the knowledge of their eſſences, of their natures, of their proprieties, of their operations, and

of whatsoever else belongeth to them all in generall, and to every one of them in particular: but our soule cannot be stored or fraught with any thing, by other meanes then by her assent or deeming: whereupon it followeth, that she cannot have her perfection, untill her deemings or judgements be perfect; which is, that they be agreeable unto the things in the world: when they are so, then are they true. And this is the reason why truth is the aime and perfection of the soule. Now then, truth residing onely in the assents and judgements of the soule, (which are the traffick whereby she enricheth her selfe with the rest of the world) and they peing framed by her discerning an identity betweene two things; which she expresseth by affirming one of them of the other: it followeth, that nothing can be true or false, but where there is a composition of two extremes, made by the ones being affirmed of the other; which is done onely in Enuntiations or judgements: whiles single apprehensions assent to nothing, and therefore settle no knowledge in the soule; and consequently are not capable of verity or falsity, but are like pictures made at fansie, some one of which may happen to be like some Person, but cannot be said to be the picture of him, because it was not drawn from him: so these bare apprehensions, because there is not in the man union of the soule to the outward world, or to the Existence which actuateth its object, therefore they make not the soule to be the image of the things existent: but the judgement, which still taketh a thing existent, or as existent, in the subject of the proposition, draweth its picture from the thing it selfe: and therefore it maketh the soule to be well or ill painted, in respect of the thing that is true or false.

And this is the reason, why in one sense doubtfull propositions, which the understanding (not being yet resolved) maketh inquiringly to informe it selfe of the truth of them, cannot be said to be true or false; for all that while, the soule yeeldeth no assent unto them, either one way or other; yet in another sense they may, which is, taking them as subjects that the understanding determineth unto it selfe to treat of: for there being two extremes in them, and the proposition consisting in this, whether these extremes be identified or no, it followeth, that since one part must of necessity be, such a proposition spoken at randome, or written by chance without designe, is of necessity either true

true or falſe; according as the extremes of it, are or are not one thing.

9. What is a ſolid judgement, and what a ſlight one.

There occurreth no more unto my conſideration to be ſaid in this place, concerning the aſſents and judgements of the mind: unleſſe it be, to explicate in a word or two, the ſeverall qualities of them, which are found in ſeverall Perſons; and to point at the reaſon why they are called by thoſe names, which they are univerſally knowne by. To which purpoſe we may obſerve, that judgement or *deeming*, being a quieting of the mind, it followeth that the mind muſt needs be at diſquiet and at unreſt, before it commeth to judge: ſo that we may conclude, that judgement or thinking, is a good attained by a former motion. Now according to the quality of this motion, the judgement or aſſent, is qualifyed and denominated. Wee muſt therefore conſider what belongeth to motion; which when wee have done, wee ſhall in judgements find ſomething proportionable thereunto.

We know there is a beginning and an ending in motion; and that there are parts by which it is drawn out in length: all which muſt be particularly conſidered, in our comparing of motions unto judgements. Now then, as he that would know preciſely the nature of any motion, muſt not begin his ſurvay of it, after it hath been ſome time in fluxe; nor muſt give over his obſerving it, before it have arrived unto its utmoſt period; but ought to carry his attention along from its firſt origine, and paſſe with it through all its parts, untill it ceaſing, give him leave to doe ſo too (for otherwiſe, it may happen that the courſe of it be differing in thoſe parts he hath not obſerved, from thoſe that he hath, and accordingly, the picture he ſhall make of it by that imperfect ſcantling, will prove an erroneous one;) ſo in like manner, when a man is to make a *judgement* of any matter in queſtion, to give a good account of it, he muſt begin at the root, and follow ſucceſſively all the branches it divideth it ſelfe into, and drive every one of them to their utmoſt extremity and period: and according as in judging he behaveth himſelfe well or ill, in the ſeverall circumſtances that are proportionable to the beginning, ending, and parts of motion; ſo his judgement is qualifyed with the names of ſeverall vertues agreeing thereunto, or of their oppoſite defects.

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If he begin his considerations very low, and from the very bottome and root of the affaire, which is from the first and all comprehending principles of the question, and proceed on orderly taking all before him; his judgement is accounted *deep, profound, and solid:* for he that casteth so farre, as to leave behind him no part of the matter he is inquiring about, & then driveth his course steadily and smoothly forwards, without any leaps over rugged passages, or interruptions, or loose breaches; must of necessity make a well grounded judgement; and such an one, as cannot easily be overthrown, or he be easily removed from it.

And this is indeed the full reason, of what a little above we only glanced at: namely, why understanding men are usually accounted obstinate in their tenets, and are hard to be removed from their opinions once setled in their minds: for when other men oppose them, they urge nothing (for the most part) against these juditious mens resolutions or beliefes, but what they have already throughly foreseen: but these on the other side, doe see a great deale, that their opposers reach not unto; so that notwithstanding all such opposition, they continue still unshaken in their *judgements:* for which, the others which see not as much as they, doe thinke them obstinate, and not led by reason, because they follow not that short reason, beyond which themselves cannot reach.

The contrary vice to this, is called a *slight judgement:* and consisteth herein, that a man out of a few, and an insufficient number of circumstances, resolveth the whole case: which temerity and short sightednesse of judgement, is significantly taxed in our English proverb, that *a fooles bolt is soone shot.*

10. What is an acute judgment, and what a dul one.

Thus much for the beginning of a judgement: the next consideration may be concerning the end of it; in regard whereof, if it reach to the utmost extent and period of what is considerable in a hard question proposed, it gaineth the title of *sharpe,* or of *subtile,* and *acute*; for the hardnesse of the matter that perplexeth ones judgement, consisteth in the involution of things, which looked upon in grosse, doe seeme to have no distinction or opposition among themselves; and yet are in truth of very different and contrary natures. Now a good judgment divideth and cutteth through them, and allotteth unto every particular thing its proper limits and bounds: wherefore, as in corporeall substances,

ces, the vertue of dividing is sharpnesse and edge, by translation from thence, such a judgement as pierceth neatly and smartly betweene contradictories that lie close together, is called *sharpe* and *acute*. In like manner, *subtility* is a vertue, whereby a liquor or other body searcheth every little hole and part of what it worketh upon, till it get through it; and from thence, it is used in judgements to signifie the same: whose opposite vice is called *dulnesse*.

11. In what consisteth quicknesse and clearnesse of judgement: and their opposite vices.

In the last place we are to examine, what proportion a judgement holdeth with the parts of motion: in these, two things are to be considered, namely the quantity or multitude of those parts, and the order of them. As for the quantity in a motion, it belongeth either to long or short, or to quick and slow: now, where the beginning and ending are already knowne and determined, and consequently where the length is determined, and dependeth not at all of the judge to alter it, (for he must take it as the matter giveth it) there a judgement can acquire no denomination of perfection or deficiency, from length or from shortnesse; for they belong originally to the matter of the judgement; and the judgement must accordingly fit it selfe to that; and therefore is liable neither to commendations nor to reproach, for being long or short: it remaineth then, that the vertue in *judging* answerable to the quantity of motion, must consist in quicknes and celerity; and the contrary vice, in slownesse and heavinesse.

As for order in the severall parts of motion, wee know that if they be well ordered, they are distinct and easily discernable. Which vertue, in our subject, is called *clearnesse of judgement*; as the contrary vice is *confusion*.

THE

## THE THIRD CHAPTER.

### *Of Diſcourſing.*

1. How diſcourſe made.

IN the laſt Chapter we have ſhewed, how two apprehenſions joyned together doe make a judgement: now in this our firſt employment will bee, to ſhew how three of theſe thoughts or judgements, well choſen and duely ordered, doe compoſe the firſt and moſt ſimple of perfect diſcourſes; which Logitians call a Syllogiſme: whoſe end and effect is to gaine the knowledge of ſomething, before hidden and unknowne. The meanes whereby this is compaſſed, is thus. By the two firſt judgements, we joyne the extremes of the propoſition we deſire to know, unto ſome third thing; and then, by ſeeing that they both are one third thing, and that one can be but one, we come to diſcerne, that truly one of them is the other; which before we ſaw not: ſo that, the *identity*, which firſt made an identicall propoſition be knowne and agreed unto, and afterwards cauſed the like aſſent to be yeelded unto thoſe maximes, whoſe identification preſently ſhewed it ſelfe, now by a little circuit and bringing in of a third terme, maketh the two firſt (whoſe identification was hidden and obſcure, whiles we looked upon the termes themſelves) appeare to be in very truth but one thing.

2. Of the figures and moods of Syllogiſmes.

The various mingling and diſpoſing of theſe three termes in the two firſt propoſitions, begetteth a variety in the ſyllogiſmes that are compoſed of them: and it conſiſteth in this, that the aſſumed terme unto which the other two are interchangeably joyned, is either ſaid of them, or they are ſaid of it: and from hence ſpring three different kinds of ſyllogiſmes; for either the aſſumed or middle terme, is ſaid of both the other two; or both they are ſaid of it; or it is ſaid of one of them, and the other is ſaid of it: neither is there any deeper myſterie then this, in the three figures, our great Clerkes talke ſo much of: which being brought into rules, to help our memory in the ready uſe of this tranſpoſition of the termes; if we ſpin our thoughts upon them into over ſmall threds, and thereof weave too intricate webs (meane while not reflecting upon the ſolid ground within our ſelves, whereon theſe rules are built, nor conſidering the true end why;)

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we may spend our time in triviall and useleſſe ſubtilities: and at length, confound and miſapply the right uſe of our naturall diſcourſe, with a multitude of precepts drawne from artificiall Logick.

But to returne to our matter in hand; under this primary threefold variety, is another of greater extent, growing out of the divers compoſition of the three termes, as they are qualifyed by *affirmation* or *negation*, and by *univerſality* or *particularity*: for that unity, which the two termes, whoſe identification is enquired after, muſt have by being joyned with the third, becommeth much varied by ſuch divers application: and from hence ſhooteth up that multitude of kinds of ſyllogiſmes, which our Logitians call Moods. All which I have thus particularly expreſſed, to the end we may obſerve how this great variety hangeth upon the ſole ſtring of *identity*.

3. That the life of man as man, doth conſiſt in diſcourſe, and of the vaſt extent of it.

Now theſe Syllogiſmes, being as it were interlaced and woven one within another, (ſo that many of them do make a long chain, whereof each of them is a link) doe breed, or rather are all the variety of mans life: they are the ſteps by which we walk in all our converſations and in all our buſineſſes: man as he is man, doth nothing elſe but weave ſuch chaines: whatſoever he doth, if warving from this worke, he doth as deficient from the nature of man: and if he doe ought beyond this, by breaking out into divers ſorts of exteriour actions, he findeth nevertheleſſe in this linked ſequel of ſimple diſcourſes, the art, the cauſe, the rule, the bounds, and the modell of it.

Let us take a ſummary view of the vaſt extent of it, & in what an immenſe Ocean one may ſecurely ſaile, by that never varying Compaſſe, when the needle is rightly touched, and fitted to a well moulded boxe; making ſtill new diſcoveries of regions, far out of the ſight and beliefe of them, who ſtand upon the hither ſhore. Humane operations are compriſed under the two generall heads of *Knowledge* and of *Action*: if we looke but in groſſe, upon what an infinity of diviſions theſe branch themſelves into, we ſhall become giddy, our braines will turne, our eyes will grow weary and dimme, with ayming onely at a ſuddaine and roving meaſure of the moſt conſpicuous among them, in the way of knowledge.

We ſee what mighty works men have extended their labours unto;

unto; not onely by wild discourses, of which huge volumes are composed, but even in the rigorous method of Geometry, Arithmetick, and Algepta; in which, an *Euclide*, an *Apollonius*, an *Archimedes*, a *Diophantus*, and their followers, have reached such admirable heights, and have wound up such vast bottomes, sometimes shewing by effects, that the thing proposed must needs be as they have set downe, and cannot possibly be any otherwise; otherwhiles, appaying the understanding (which is never truly at rest, till it hath found the causes of the effects it seeth) by exposing how it commeth to be: so that the Reader calling to mind, how such a thing was taught him before, and now finding another unexpectedly convinced upon him, easily seeth that these two put together, doe make and force that third to be, whereof hee was before in admiration how it could be effected: which two wayes of discourse, are ordinarily knowne by the names of *Demonstrations*; the one called *à priori*, the other *à posteriori*.

Now if we look into the extent of the deductions out of these, we shall find no end. In the heavens, we may perceive Astronomy measuring whatsoever we can imagine; and ordering those glorious lights, which our Creator hath hanged out for us; and shewing them their wayes, and pricking out their paths, and prescribing them (for as many ages as he pleaseth before hand) the various motions they may not swarve from in the least circumstance. Nor want there sublime soules, that tell us what metall they are made of, what figures they have, upon what pillars they are fixed, and upon what gimals they move and performe their various perious: witnesse that excellent and admirable worke, I have so often mentioned in my former Treatise. If we look upon the earth, we shall meet with those, that will tell us how thick it is, and how much roome it taketh up: they will shew us how men and beasts are hanged unto it by the heeles; how the water and aire doe cover it; what force and power Fire hath upon them all; what working is in the depths of it; and of what composition the maine body of it is framed: where neither our eyes can reach, nor any of our senses can send its messengers to gather and bring back any relations of it. Yet are not our Masters contented with all this: the whole world of bodies is not enough to satisfye them: the knowledge of all corpo-

Dialo: de mundo.

reall

reall things, and of this machine of heaven and earth, with all that they encloſe, cannot quench the unlimited thirſt of a noble mind, once ſet on fire with the beauty and love of Truth.

*Æſtuat infœlix, anguſto limite mundi,*
*Vt Gyaræ clauſus ſcopulis, parvâque ſeripho.*

But ſuch heroick ſpirits, caſt their ſubtile nets into another world, after the winged inhabitants of the heavens; and finde meanes to bring them alſo into account, and to ſerve them (how imperceptible ſoever they be to the ſenſes) as dainties at the ſoules table. They enquire after a maker of the world we ſee, and are our ſelves a maine part of; and having found him, they conclude him (out of the force of contradiction) to be eternall, infinite, omnipotent, omniſcient, immutable, and a thouſand other admirable qualities they determine of him. They ſearch after his tooles and inſtruments, wherewith he built this vaſt and admirable pallace, and ſeeke to grow acquainted with the officers and ſtewards, that under him governe this orderly and numerous family. They find them to be inviſible creatures, exalted above us more then we can eſtimate, yet infinitely farther ſhort of their and our Maker, then we are of them. If this doe occaſion them to caſt their thoughts upon man himſelfe, they find a nature in him (it is true) much inferiour to theſe admirable *Intelligences*, yet ſuch an one, as they hope may one day arrive unto the likeneſſe of them: and that even at the preſent, is of ſo noble a mould, as nothing is too big for it to faddome, nor any thing too ſmall for it to diſcerne.

Thus we ſee knowledge hath no limits; nothing eſcapeth the toyles of ſcience; all that ever was, that is, or can ever be, is by them circled in: their extent is ſo vaſt, that our very thoughts and ambitions are too weak and too poore to hope for, or to ayme at what by them may be compaſſed. And if any man, that is not inured to raiſe his thoughts above the pitch of the outward objects he converſeth dayly with, ſhould ſuſpect that what I have now ſaid, is rather like the longing dreames of paſſionate lovers, whoſe deſires feed them with impoſſibilities, then that it is any reall truth; or ſhould imagine that it is but a Poetike Idea of ſcience, that never was nor will be in act: or if any other, that hath his diſcourſing faculty vitiated and per-

perverted, by having been imbued in the ſchooles with unſound and umbratile principles, ſhould perſwade himſelfe, that howſoever the pretenders unto learning and ſcience, may talk loud of all things, and make a noiſe with Scholaſtick termes, and perſwade their ignorant hearers that they ſpeak and unfold deep myſteries, yet in very truth, nothing at all can be knowne: I ſhall beſeech them both to ſuſpend their conjectures or beliefes herein, and to reſerve their cenſure of me, whether or no I have ſtrained too farre, untill the learned Author of the Dialogues of the world, have enriched it with the work he hath compoſed of Metaphyſikes: in which, going orderly and rigorouſly by continued propoſitions, in ſuch ſort as Mathematicians demonſtrate their undertakings, he hath left no ſcope for wrangling braines to make the leaſt cavill againſt his doctrine: and caſting his ſharp ſighted thoughts over the whole extent of nature, and driving them up to the Almighty Author of it, he hath left nothing out of the verge of thoſe rules, and all comprehending principles he giveth of true ſcience. And then I doubt not, but they will throughly abſolve me from having uſed my amplification, in aymings at the reach of this allgraſping power. For my part, the beſt expreſſion that I am able to make of this admirable piece, I muſt borrow from witty *Galileus*, when hee ſpeaketh of *Archimedes* his long miſſed booke of glaſſes; and profeſſe, that having ſome of the Elements or bookes of it entruſted in my hands by the Author, I read them over with extream amazement, as well as delight, for the wonderfull ſubtility, and ſolidneſſe of them.

4. Of humane actions, and of thoſe that concern our ſelves.

Thus much for knowledge. Now let us caſt an eye upon humane actions. All that we doe (if we doe it as we ſhould doe, and like men) is governed and ſteired by two ſorts of qualities: the one of which, we call *Arts*; the other *Prudences*. An art, is a collection of generall rules, comprehending ſome one ſubject, upon which we often worke. The matters we work upon (out of which the particular ſubjects of arts doe ſpring) are of 3. kinds: our ſelves, our neighbours, and ſuch dumbe or inſenſible things, as compoſe the reſt of the world.

Our actions upon our ſelves, are the higheſt and the nobleſt of all the reſt, and thoſe by which we live and work as men: or to expreſſe my ſelfe better, they are thoſe by which we perfect

that

that part of us, which maketh us men, and by which wee direct and levell all wee doe, according to the rule of reason; not suffering our actions to swarve from what shee dictateth unto us. This is done, by multiplying and heightning the thoughts of those things, which maintain us in reason; whether the motives bee morall, as the examples of worthy persons, and the precepts and perswasions of wise men, and the like, or whether they be naturall, as the consideration of the sweet and contented life, which vertue giveth us here, by good conversation, honour, profit, quiet, pleasure, and what else soever groweth out of so excellent a root: as also, of the beatitude and happy state it bringeth us to in the next; and of the contrary effects which spring from vice. Againe, by observing the motives and wayes of our passions and animall desires, we learn how to prevent them; how to terrify them; and how to wear them gently away by litle and litle, through sometimes giving them diversions, through otherwhiles restraining them with moderation, and through oftentimes cutting of the occasions, and abridging them of their naturall encreasings. All these things are brought into art and rule; whose lessons, were men but as carefull and industrious to study, as they are to become Masters in vaine and triviall things, they would enjoy happy lives.

5. Of humane actions as they concerne our neighbours.

In the next place, we are to consider the actions whereby we work upon our neighbours. They are chiefly *government* and *negotiation*: both which are of one kind; and have but this difference, that the one is done in common, the other is performed in particular. The means by which we command, are rewards and punishments; which who hath in his hands, may assuredly by wise using them, bring to passe whatsoever he hath a mind unto.

Upon occasion of mentioning these two powerfull motives, which have so maine an influence in mens actions, we may note by the way, that many of them, and that work most forcibly upon mens minds, are things whose subsistence we know not where to find; as honour, praise, glory, command, singularity, eminencie, shame, infamy, subjection, reproach, and the like: unto any of which, none of our senses can reach; and yet they govern mans life, in a manner wholly and perfectly.

In *negotiation*, wee propose to single men their owne interests and profits; not such as the proposer can, or will effect, but

ſuch as are likely to ariſe out of the action wee endeavour to draw him unto with whom we treat. In both theſe, the uſuall labour is, to make our neighbours willing to leave ſome preſent good; in hope of a greater to come; or to be content to undergoe ſome preſent harme, for feare of a greater to enſue. The generall inſtrument which they uſe, is *diſcourſing*; whoſe vertue conſiſteth partly in our owne mind, and partly in delivering our mind to others: for firſt we muſt know what we ſhould ſay, and next in what manner we ſhould ſay it.

6. Of Logick. The art which directeth our owne mind, and teacheth us what to ſay, is *Logicke*: whoſe parts are two; according as the affaires falling into diſcourſe, are likewiſe of a twofold nature: the one inſtructeth us how to manage and order our reaſon, when it dealeth with ſuch ſubjects as wee may attaine to certainty in. And here the rules of *Demonſtration* take place; teaching us to define, to divide, and to conclude. The other inſtructeth us how to behave our ſelves, when we meet with ſuch ſubjects, as a good & probable gueſſe is the fartheſt wee can reach unto towards the knowledge of them: and for theſe, the *Topicall* part of Logick ſerveth; the which, taking a view of all the accidents belonging to any thing propounded, ſheweth how to draw probabilities from every one of them.

7. Of Grammar. Our diſcourſing to others, is either to open our mindes barely unto them; or to perſwade them of ſomewhat our ſelves believe; or to winne them to ſomewhat wee would have them doe. For the bare delivery of our minds to others, we have *Grammar*; the ſcope of which art, conſiſteth firſt, in teach us to deliver our conceptions plainly and clearly, (which is the maine intent of ſpeaking) next, in making, our diſcourſe bee ſuccinct and briefe, (which is the meaſure of our ſpeaking, both for our ſelves and others;) and laſtly, in ſorting our words, ſo as what wee ſay, may bee accompanied with ſweetneſſe; both in common, in regard of the eare, by avoyding ſuch harſh ſounds as may offend it; and in particular, in regard of the cuſtome of the language wherein we ſpeak, and of the perſons to whom we ſpeak.

8. Of Rhetorick. The art whereby we may perſwade others, and winne them to aſſent unto what we would have them, is *Rhetoricke*. Her rules inſtruct us how to diſpoſe and order with beſt advantage, in regard of

of the Auditours disposition, both the reasons which *Logicke* affordeth us, and the words which *Grammar* storeth us with: as also, how to give life and motion to what we say, by our action and gesture; that so we may perswade our Auditory, such passions raigne in us, as we seek to stirre up in them: for as we may observe, that one who yawneth, maketh another likewise yawne; and as our seeing others laugh, provoketh laughing also in us (the reasons whereof wee have touched in the former Treatise;) after the same manner, what passion soever we exhibite in our selves, the same stealeth insensibly upon those wee speak unto; whiles their mind attending to the words they heare, is not aware of the subtile spirits motions, that by a kind of contagion rise and swell in their hearts: according to which naturall inclination in all men, the Master of Poets and excellent observer of mens humours said passing well:

*Si vis me flere, dolendum est*
*Primùm ipsi tibi.*

Hence grow those encreases by metaphors, hyperboles, and other tropes and figures: hence those fervors by interrogations, exclamations, apostrophes, and the like; which when they are fitly placed, they carry the Auditour even against his will.

*Poetry*, is not a governour of our Actions, but by advantagious expressing some eminent ones, it becometh an usefull director to us; and therefore challengeth a place here. The designe of it is, by representing humane actions in a more august and admirable hew, then in themselves they usually have: to frame specious Ideas, in which the people may see, what is well done, what amisse, what should be done, and what by errour is wont to be done: and to imprint in mens minds a deep conceit of the goods and evils, that follow their vertuous or vitious comportment in their lives. 9. Of Poetry.

If those who assume the title of *Poets*, did ayme at this end, and would hold themselves strictly to it, they would prove as profitable instruments as any the commonwealth had: for the delightfulnesse and blithnesse of their compositions, inviteth most men to be frequently conversant with them; (either in songs, or upon the stage, or in other Poemes) whiles the sober aspect and severity of bare precepts, deturneth many from lending a pleased

eare to their wholesome doctrine; and what men swallow with delight, is converted into punishment: so that, if their drift were to settle in mens minds a due valuation of vertue, and a detestation of vice, no art would doe it more universally, nor more effectually: and by it, mens hearts would be set on fire to the pursuit of the one, and be shrunk up with dislike and horrour against the other. But unto such a Poet as would ayme at those noble effects, no knowledge of *Morality*, nor the nature and course of humane actions and accidents must be wanting: he must be well versed in *History*; he must be acquainted with the progresse of nature, in what she bringeth to passe; he must be deficient in no part of *Logicke*, *Rhetoricke*, or *Grammar*: in a word, he must be consummate in all arts and sciences, if he will be excellent in his way.

10. Of the power of speaking.

But whiles we thus entertain our selves with those arts, which serve us in discoursing with others, it were a great oversight to forget that faculty, which is the *basis* and ground-work of all those: and that is, the power of speech, which nature hath bestowed upon us. It consisteth in two actions: the one outward, the other inward: the outward, is the giving of various sounds to our breath, as it passeth through our mouth, by divers conjunctions of our tongue, teeth, and lips, to themselves, or to divers parts of our mouth, or by their separations from them: in which, we see that birds are able to imitate us, and I am perswaded, the like might be effected by insensible creatures, if a dexterous man would employ his time, in cotriving and making an instrument to expresse those different sounds; which, not having more then seven substantiall differences besides the vowels (as some who have carefully noted them, doe affirme) it would peradventure be no hard matter to compose such an engine.

The inward action of locution, is the framing of convenient answers to what is asked; of fit replyes to what is said; and in a word, to speak appositely, and to the purpose: whereunto, neither beast nor dead instrument can be brought, unlesse the artificier be able to endue it with understanding.

11. Of arts that concern dumbe and insensible creatures.

All other arts, instruct us how to work orderly upon beasts and insensible bodies: by some of them, we cultivate living creatures, as when husband-men nourish sheep, oxen, foule, and the like, for slaughter: by others, we discipline them, as when we teach

teach horſes, dogges, apes, hawkes, parrats, and ſome kind of fiſhes, to hunt, to play, and in a word, to doe ſomewhat either for our profit, or for our pleaſure: and again, by others we uſe their natures to our ends; as when wee lay baits to catch them, when when we ſet egges under hennes, to have the chickens, and the like: by other arts, we work as powerfully upon inſenſible creatures; among which, by knowing the natures of divers trees, herbes, minerals, &c. we are able to bring any of them to what uſe ſoever we find moſt expedient for our ſervice: from hence grow all thoſe arts and trades, in which we ſee men dayly ſpend their whole lives; ſo as it is needleſſe to inſiſt upon the particulars of them, ſince Townes and the Cities are compoſed of the ſeverall Tribes of perſons that profeſſe them and live by them.

But we muſt not leave this ſubject, without noting how admirably mans wit turneth it ſelfe to ſo different ſorts, and to ſuch an infinite variety of things. For what man is there, (if he be a man) but might have become Maſter in any of theſe ſo differing trades, in caſe he had applyed himſelfe as conſtantly to that, as he hath done to ſome other he is perfect in? Againe, let us conſider how it happeneth often, that hee doth not the ſame thing twice the ſame way, but according to his own, or another mans fanſie, changeth his work at will, now doing it after one faſhion, now after another; as having no law or determination from nature, but being wholly left to his owne direction.

12. Of Arithmetick.

There remaineth one art, not yet ſpoken of; which knoweth not where to challenge a place, whether among the moderatours of our owne actions, or among thoſe whereby we govern things: and that is *Arithmeticke*: which ſeemeth to belong unto things, and yet it medleth not with them: and againe, it ſeemeth to be a maine directour of our internall actions, and yet belongeth neither to *Morals*, nor to *Logicke*. Whereſoever its due be to place it, I am ſure its not to be forgotten; ſeeing it is ſo principall an one, as our life can hardly conſiſt without it. It worketh upon notions that are no where; for every thing that is in the world, is but one; and to be, or to make a number, cannot happen without an underſtanding: the affections likewiſe of them, are as the ſubject, all inviſible; as to be even or odde, to be cubes, ſquares, rootes, &c. and yet how great the power and extent of this

art is, none can rightly understand or believe, but hee that hath the knowledge of it, or hath seene the vertue and efficacity of it.

15. Of Prudence.

All these arts, consist in common rules, which require the second of those qualities, whereby we said humane actions are governed, to apply them to their particular matter: and that is *Prudence*; which we may define to be, a quality or power, by whose assistance we apply unto the matter we are to work upon, such instruments, as in our present judgement appeare fittest to bring it to that passe, which serveth best for our intentions, when by our senses, or by other guesses, we know the particular dispositions of the matter, and of the instruments wherewith we are to change it. Now howbeit this occurreth generally in all arts, yet its speciall place and necessity, is in governing and moderating our owne or other mens *Morall* actions; and accordingly, its name is especially addicted thereunto: and that man is said to be prudent or discreet, who governeth himselfe and others well.

This quality of *Morall Prudence* in generall, is divided into three particular ones: the first of which belongeth to a governour in a state or commonwealth: the next may be assigned to to him that is skilfull in the lawes: and the third concerneth the managing and conduct of military actions. The reason of this long received distribution peradventure is, because in these occurrences, our passion swayeth us generally more then in any others: and the operation and effect of *Prudence*, (whose Province is to curbe and moderate our passions by reason) is greatest, and appeareth most in those subjects, where passion raigneth usually with greatest impetuosity.

14. Observations upon what hath been said in this Chapter.

Thus have we runne over the maine parts of discourse, and the generall heads of mans action as man: which peradventure may through their numerousnesse, appeare to bee as it were but loosely scattered from our penne; (as happeneth unto all materials, that must serve for after buildings; and that till they bee employed, require no more but sorting, and laying together in severall heapes, to the end they may bee ready for use:) and therefore before wee goe any further, it will not bee amisse to make reflexions upon what wee have said; and to draw it nearer our intended scope; and to square out and give some figure and

polishing

poliſhing to theſe ſtones, here where we digge them out of the quarry, whereby they may hereafter with leſſe adoe, fit the places we have aſſigned them, in the ſtructure we intend: and ſo, a little trouble here, whiles our tooles are ſtill in our hands, and our matter lyeth ready for our ſtroakes, and our thoughts are warmth with working upon them, may ſave us a great deale there, where our maine imployment will bee, to lay artificially; and to joyne cloſely, what now we but hew out: and therefore will require finer inſtruments, and a ſharper edge, then what at preſent ſerveth our turne.

Let us then bring back to account all we have ſaid in this Chapter: and when we have well reflected upon every particular, we ſhall find they all agree in this, that they are nothing elſe but a due ordering of one thing with another: a ſyllogiſme is an ordering of ſome few notions: a ſcience is an ordering of ſyllogiſmes, in ſuch ſort, as a new Propoſition may follow out of thoſe which went before: and as we ſee that when by our thoughts divers ſyllogiſmes are well ordered, hidden things come to be diſcloſed in our underſtanding; even ſo among bodies, if things whoſe proprieties are knowne, be likewiſe ordered and put together, thoſe very effects, which were diſcovered by the ordering of notions in our head, will ſpring forth in nature: as for example, if by knowing the natures of fire and of towe, our diſcourſe findeth that towe put to fire will preſently become fire, the ſame will happen in nature, if we put materiall towe, or ſome other body that hath the qualities of it, to reall fire, or to ſome other ſubſtance that is endewed with the vertues of fire: in like manner, if by knowing that colours are nothing elſe, but various mixtures of light and of darkneſſe in bodies, our diſcourſe aſſureth us, that by ſeverall compoundings of theſe extreames, reds, blewes, yellowes, greenes, and all other intermediate colours may be generated; accordingly wee ſhall find in effect, that by the ſeverall minglings of black and white bodies (becauſe they reflect or drowne light moſt powerfully) or by interweaving ſtreames of pure light and of ſhadowes one with another, wee may procreate new colours in bodies, and beget new luminous appearances to our eyes: ſo that hence it apppeareth clearly, that the ſame nature is in our underſtanding, and in the things: and that the ſame ordering, which in

the one maketh science, in the other causeth naturall transmutations.

Another reflexion, which will be fit for us to make upon these long discourses, is this, that of necessity there must be a joyning of some things now actually in our knowledge, unto other things we think not of: for it is manifest, that wee cannot at the same time actually think of a whole book of Euclide, and yet to the due knowledge of some of the last Propositions, the knowledge of almost all the former is required: likewise it is impossible we should at the same time think of all the multitude of rules belonging to any art, as of Grammar, of Metering, of Architecture; and yet when we write in Latine, make a Poeme, or lay the design of a house, we practise them whiles we think not of them, and are assured we goe not against them, however wee remember them not.

Nay, even before we know a thing, we seem to know it; for since we can have a desire of nothing, but of what we know, how could we desire to know such or such a thing, unlesse wee know both it, and the knowledge of it? And for the most part we see a horse, or man, or herbe, or workmanship, and by our sense have knowledge that such a thing it is, before we know what, or who, or how, it is: that groweth afterwards out of the diligent observation of what we see: which is that, whereby learned men differ from the unlearned, for what striketh the sense, is knowne alike by them both; but then here is the difference betweene them, the latter sort sitteth still with those notions, that are made at the first, by the beating of our sense upon us, without driving them any further: and those that are learned, doe resolve such compounded notions, into others made by more common beatings, and therefore more simple: and this is all the oddes in regard of knowledge, that a Scholler hath of an unlettered man.

One observation more wee will draw out of what wee have said, and then end this Chapter: it is, how a man doth oftentimes enquire among his owne thoughts, and turneth up and down the images hee hath in his head, and beateth his brains, to call such things into his mind, as are usefull unto him, and are for the present out of his memory: which, as we see it so necessary, that without it no matter of importance can bee performed in the way

of

of discourse (whereof I my selfe have too frequent experience in the writing of this Treatise) so on the other side, we cannot perceive that any creature besides Man, doth it of set purpose and formally as Man doth.

## THE FOURTH CHAPTER.

### *How a man proceedeth to Action.*

HAving thus taken a summary view of the principall Qualities a man is endued withall, *Apprehending*, *Iudging*, and *Discoursing*; and having shewed how he is inriched in and by them with the natures of all things in the world; it remaineth for our last work in this part, to consider in what manner hee maketh use of this treasure in his ordinary actions: which it is evident are of two different kinds, and consequently have two severall principles, Vnderstanding and Sense, they sway by turnes, and sometimes joyne together, to produce a mixed action of both.

1. That humane actions proceed from two severall principles, Understanding and Sense.

If onely Sense were the fountaine from whence his actions spring, we should observe no other straine in any of them, then meerely that according to which Beasts performe theirs: they would proceed evermore in a constant unvaryable tenour, according to the law of materiall things, one body working upon another, in such sort as we have declared in the former Treatise.

On the other side, if a man were all understanding, and had not this bright lampe encloſed in a pitcher of clay, the beames of it would shine without any allay of dimnesse, thorough all he did; and he could doe nothing contrary to reason, in pursuit of the highest end he hath prefixed unto himselfe; for he neither would, nor could doe any thing whatsoever, untill he had first considered all the particular circumstances, that had relation to his action in hand; and had then concluded, that upon the whole matter, at this time, and in this place, to attaine this end, it is fitting and best to doe thus or thus: which conclusion could be no sooner made, but that the action would without any further disposition on his side, immediately ensue, agreeable to the prin-

principles it ſpringeth from. Both parts of this aſſertion are manifeſt: for the firſt, it is evident, that whenſoever an Agent worketh by knowledge, he is unreſolved whether hee ſhall worke or not worke, as alſo of his manner of working, untill his knowledge (that ought to direct and governe his working) be perfect and complete: but that cannot be, as long as any circumſtance not as yet conſidered, may make it ſeeme fit or unfit to proceed: and therefore, ſuch actions as are done without exact conſideration of every particular circumſtance, doe not flow from a pure underſtanding. From whence it followeth, that when an underſtanding is not ſatisfyed of every particular circumſtance, and conſequently cannot determine what he muſt immediately doe, but apprehendeth that ſome of the circumſtances not as yet conſidered, may (or rather muſt) change ſome part of his action, it muſt of neceſſity be undermined in reſpect of the immediate action; and conſequently, it muſt refraine abſolutely from working. The other part is cleare; to wit, that when the underſtanding, upon conſideration of all circumſtances, knoweth abſolutely what is beſt, the action followeth immediately (as farre as dependeth of the underſtanding) without any further diſpoſition on his behalfe: for ſeeing that nothing but knowledge belongeth to the underſtandiug, he who ſuppoſeth all knowledge in it, alloweth all that is requiſite or poſſible for it to worke by: Now if all be put, nothing is wanting that ſhould cauſe it to worke: but where no cauſe is wanting, but all requiſite cauſes are actually being, the effect muſt alſo actually be, and follow immediately out of them: and conſequently, the action is done, (in as much as concerneth the underſtanding, and indeed abſolutely, unleſſe ſome other cauſe doe faile) as ſoon as the underſtanding knoweth all the circumſtances belonging to it: ſo as it is manifeſt out of this whole diſcourſe, that if a man wrought onely by his underſtanding, all his actions would be diſcreet and rationall, in reſpect of the end he hath propoſed to himſelfe; and till he were aſſured what were beſt, he would keepe himſelf in ſuſpenſe and doe nothing; and as ſoone as he were ſo, he would admit of no delayes, but would at the inſtant proceed to action according to his knowledge: the contrary of all which, we dayly ſee by experience in every man.

We

We may then safely conclude, that in humane nature there are two different centers, from whence crosse actions doe flow: the one he hath common with beasts, and whose principles and laws we delivered in the former Treatise, where we discoursed of life, and the motions of life and of passions: the other is the subject of our present enquiry; which in this place, expecteth at our hands, that we should consider how it demeaneth it selfe, and what it doth in us, when by its guidance we proceed to any action. Experience must be our informer in generall: after which, our discourse shall anatomise what that presenteth us in bulke. She giveth us notice of three especiall effects of our understanding: first, that it ordereth aright those conceptions which are brought unto it; secondly, that when they appeare to be not sufficient for the intended worke, it casteth about and seeketh out others: and thirdly, that it strengthneth those actions which spring from it; and keepeth them regular and firme and constant to their beginnings and principles. Unto which last seemeth to belong, that it sometimes checketh its own thoughts, and bringeth back those it would have, and appeareth to keep as it were a watch over its owne wayes.

2. How our generall and inbred maximes doe concur to humane action.

As for the ordering of the present notions, it is cleare that it is done by a secret dependance from the rules of discourse, and from the maximes of humane action: I call this dependance a secret one, because a man in his ordinary course, maketh use of those rules and *maximes* which serve his turne, as though they were instilled into him by nature, without so much as ever thinking of them, or reflecting upon them to square out his actions by them: nay, some of them so far out of the reach of most men, as they cannot think of them, though they would; for they know them not: as in particular, the rules of discourse; the use of which is so necessary, as without it no man can converse with another, nor doe any thing like a man, that is, reasonably. From whence then can this proceed, that so familiarly and readily a man maketh use of what he is not conscious to himselfe that he hath any acquaintance withall? It can be nothing else, but that the soule, being in her owne nature ordered to doe the same thing, which Scholars with much difficulty arrive to know what it is by reflection and study, and then frame rules of that afterwards carry their discourse to a higher pitch, she by an inborne vertue maketh

maketh a man doe it orderly, constantly, and certainly.

3. That the rules and maximes of arts doe worke positively in us though wee think not of them.

The like may be observed in the dayly use men make of the *maximes* of humane action: which are certain knowledges that formerly they have gotten, but that they usually think not of, whiles they work agreeable to them; yet it seemeth they work by them; for if their action should jarre against any of them, they would presently reflect upon their *Maxime*, and by it correct what they were about: for example, one who is skilled in the rules of *Grammar*, or of accenting his speech, or hath his eare used to *Musick*; whiles he heareth true construction, or even verse, or consonant song, never reflecteth how it is made; or at most doth but consider in grosse that it is right: but if a solecisme, or false quantity, or discord intervene, he presently is aware, not onely that it is amisse, but remembreth the very particular precise rule, against which the breach is made.

This at the first sight might occasion us to imagine, that the rules by which any composition is made, doe worke onely negatively in us, whiles we are busie about it: that is, that they contribute nothing to the making of the thing, but onely hinder us from committing errors: but if we consider the matter well, we shall find it impossible, but that they should work even positively in us; for we know that when we first learne any of these things, we look industriously for such a gender, or number, or case, or tense, for such a foot or quantity, such a note, or consonance; and we are sure, that use and practice of the same thing, doth not change, but onely facilitate the worke: therefore it followeth of necessity, that we still use those very instructions, by which at the first we could but slowly creepe, but now manage them with such celerity, as our fancie cannot keep pace with what we do. And this is the reason why we do not perceive that we think of them, but may peradventure at the same time think of a quite different matter; as when a Musitian playeth voluntary division upon a ground he never saw before, and yet hath all the while some other thought in his head; or when a Painter draweth a picture, and all the while discourseth with a by-stander.

This truth may be convinced by another argument: as thus; it cannot be doubted, but that a verse or song is made by the *power* of making such compositions: but that *power* is the art of them; and that art is nothing else but the rules whereby they are made:

made: and accordingly we see, that who hath not the art, cannot make such compositions: but who hath, can when he pleaseth: and if any man would be able to make them, he presently studyeth the art: so that it cannot be doubted, but that artificiall things are alwayes made by the use of those rules which teach the making of them; although for the most part we are not able to perceive how such rules are used: and besides this, we are sure that we doe not onely make use of those rules we learned at the first, but when we are arrived to Maistery in any art, we make use of them in a quite different manner then we did in the beginning, and then we doe in any other thing, wherein we find paine and difficulty.

4. How the understanding doth cast about when it wanteth sufficient grounds for action.

In the second effect that we experience of our understanding, (which is, our casting about for new conceptions, when those it already hath, appear not sufficient to direct what it hath in hand) the force and working of it, is very evident: for this effect proceedeth out of a want of satisfaction: and this belongeth properly to the understanding; for if evidence and satisfaction be qualities of it, then of necessity the privation of these qualities, must likewise belong unto it; as also to discerne that privation, and to use meanes to avoid it: and in the very casting about, we see a choice made: and that things are not taken promiscuously as they come of a row, but that some of them are set aside, & others advanced for use: which argueth plainly the knowledge and government of the understanding.

5. How reason doth rule over sense and passion.

But the third operation, is that which giveth cleerest evidence of the peculiar and distinct working of the understanding: for if we mark the contestation and strife within us, between our sensuall part and his antagonist which maintaineth the resolution set by reason, and observe how exceedingly their courses and proceedings differ from one another; we shall more plainly discern the nature, and power, and efficacie of both of them. We may perceive that the motions against *Reason*, rise up turbulently, as it were in billowes, and like a hill of boyling water (as truly *Passion* is a conglobation of spirits) doe put us into an unquiet and distempered heat and confusion: on the other side, *Reason* endeavoureth to keepe us in our due temper, by sometimes commanding downe this growing sea; otherwhiles, by contenting in some measure the desires of it, and so diverting another way

way its unruly force: ſometimes ſhe terrifyeth it, by the propoſall of offenſive things joyned unto thoſe it is ſo earneſt to enjoy: Againe, ſometimes ſhee preventeth it, by cutting off all the cauſes and helpes that promote on its impotent deſires, and by engaging before hand the power of it in other things, and the like.

All which doe evidently convince, that as *Reaſon* hath a great ſtrength and power in oppoſition of ſenſe, ſo it muſt be a quite different thing, and of a contrary nature unto it: we may adde, that the worke of *Reaſon* can never be well performed, but in a great quiet and tranquillity; whereas the motions of *Paſſion*, are alwayes accompanyed with diſorder and perturbation: ſo as it appeareth manifeſtly that the force of *Reaſon*, is not purely the force of its inſtruments, but the force of its inſtruments as they are guided, and as the quantities of them are proportioned by it: and this force of *Reaſon*, is different from the force of its inſtruments in themſelves, in ſuch ſort as the force of a ſong, is different from the force of the ſame ſounds, whereof it is compoſed, taken without that order which the Muſitian putteth in them: for otherwiſe the more ſpirits that are raiſed by any thought (which ſpirits are the inſtruments whereby *Reaſon* performeth all her operations in us) the more ſtrongly *Reaſon* ſhould worke; the contrary of which is evident, for we ſee that too great abundance of ſpirits confoundeth *Reaſon*.

6. How we recall our thoughts from diſtractions.

This is as much as at preſent I intend to inſiſt upon, for proofe that our underſtanding hath its proper and diſtinct operations, and worketh in a peculiar manner, and in a quite different ſtrain from all that is done by our ſenſes. Peradventure ſome may conceive, that the watchfulnes and recalling of our thoughts back to their enjoyned work, when they break looſe and run aſtray, & our not letting them range abroad at randome, doth alſo convince this aſſertion: but I confeſſe ingeniouſly, the teſtimony of it ſeemeth not cleare to me; and therefore I ranke it not with thoſe, that I would have (if it may be) ſolidly weighty, and undenyable to who ſhall conſider maturely the bottome and full efficaciouſnes of them. Of ſuch, a few, or any one, is enough to ſettle ones mind in the beliefe of a truth: and I hope, that this which we have laboured for in this Chapter, is ſo ſufficiently proved, as we need not make up our evidence with number of teſtimonies.

But

But to ſhew the exceptions I take againſt this argument, let us examine, how this act within us which we call watchfulneſſe, is performed: truly, me thinketh it appeareth to be nothing elſe, but the promptitude and recourſe of ſome ſpirits, that are proper for this effect, which by a mans earneſtneſſe in his reſolution, doe take a ſtrong impreſſion, and ſo are ſtill ready to knock frequently at the doore of our underſtanding, and thereby enable it with power to recall our ſtrayed thoughts. Nay, the very reflexion it ſelfe, which we make upon our thoughts, ſeemeth unto me to be onely this, that the object beating upon the fanſie, carryeth back with it at its retyring from thence, ſome little particle or atome of the braine or *Septum Lucidum*, againſt which it beateth, ſticking upon it; in like manner as upon another occaſion, we inſtanced in a ball reboundlng from a greene mudde wall, unto which ſome of the matter of the wall muſt needs adhere: now this object, together with the addition it getteth by its ſtroake upon the fanſie, rebounding thence, and having no more to doe there at preſent, betaketh it ſelfe to reſt quietly in ſome cell it is diſpoſed into in the braine, as we have delivered at large in our former Treatiſe, where we diſcourſed of *Memorie*: but whenſoever it is called for againe by the fanſie, or upon any other occaſion returneth thither, it commeth as it were capped with this additionall piece it acquired formerly in the fanſie; and ſo maketh a repreſentation of its own having been formerly there.

Yet, be theſe actions performed how they will, it cannot be denyed, but that both of them are ſuch, as are not fit, nor would be any wayes uſefull to creatures, that have not the power of ordering their owne thoughts and fanſies, but are governed throughout meerely by an uniform courſe of nature: which ordering of thoughts, being an operation feaſible onely by rationall creatures, and by none others, theſe two actions (which would be in vaine, where ſuch ordering is not uſed) ſeeme to be ſpecially ordained by nature, for the ſervice of *Reaſon* and of the *Vnderſtanding*; although peradventure a preciſe proper working of the underſtanding, doe not cleerely ſhine in it. Much leſſe can we by experience finde among all the actions we have hitherto ſpoken of, that our *Reaſon* or *Vnderſtanding* worketh ſingly and alone by it ſelfe, without the aſſiſtance and conſortſhip of the

the fantasie: and as little can I tell how goe about to seeke any experience of it.

7. How reason is sometimes overcome by sense and passion.

But what *Reason* may doe in this particular, we shall hereafter enquire: and end this Chapter, with collecting out of what is said, how it fareth with us, when we doe any thing against *Reason*, or against our owne knowledge. If this happen by surprise, it is plaine that the watch of *Reason* was not so strong as it should have been, to prevent the admittance or continuance of those thoughts, which worke that transgression. Againe, if it be occasioned by *Passion*, it is evident that in this case, the multitude and violence of those spirits which *Passion* sendeth boyling up to the fantasie, is so great, as the other spirits, which are in the jurisdiction and government of *Reason*, are not able for the present to ballance them and stay their impetuosity, whiles she maketh truth appeare. Sometimes wee may observe, that *Reason* hath warning enough, to muster together all her forces, to encounter, as it were in set battaile, the assault of some concupiscence, that sendeth his unruly bands to take possession of the fansie, and constraine it to serve their desires, and by it to bring *Reason* to their bent. Now if in this pitched field shee loose the bridle, and be carryed away against her owne resolutions, and be forced like a captive to obey the others lawes, it is cleare that her strength was not so great as the contrary factions.

The cause of which is evident; for we know that she can doe nothing, but by the assistance of the spirits which inhabit the braine: now then it followeth, that if she have not the command of those spirits which flock thither, she must of necessity be carryed along by the streame of the greater and stronger multitude; which in our case, is the throng of those that are sent up into the braine by the desired object; and they come thither so thick and so forcibly, that they displace the others which fought under *Reasons* Standard: which if they doe totally, and excluding Reasons party, doe entirely possesse the fansie with their troupes, (as in madnesse and in extremity of sudden passion it happeneth) then must *Reason* wholly follow their sway, without any strugling at all against it; for whatsoever beateth on the fansie, occasioneth her to worke; and therefore when nothing beateth there but the messengers of some sensuall object, she can

make

make no resistance to what they impose: but if it happen that these tumultuary ones, be not the only spirits which beat there, but that *Reason* hath likewise some under her jurisdiction, which keep possession for her, though they be too weak to turne the others out of doores; then it is true, she can still direct fairely, how in that case a man should govern himself; but when he cometh to execute, he findeth his sinews already possessed, and swelled with the contrary spirits; and they keeping out the smaller and weaker number, which reason hath ranked in order, and would furnish those parts withall, he is drawne even against his judgement and *Reason*, to obey their appetites, and to move himself in prosecution of what they propose; in such sort as the Poet expresseth that *Medea* found in her selfe, when she complained and bemoaned her selfe in these words; *Video meliora proboque, Deteriora sequor*: and in this case, a man foreseeth his misery all the way he rouleth towards it, and leapeth into the precipice with his eyes open: which sheweth that the Army of thoughts on *Reasons* side, should be encreased in number, to have her strong enough to wage battle with the rebellious adversary: or else, that her adversary should be so much weakned, that she, though not grown stronger in her selfe, yet might, through the others enfeebling, be able to make her party good; (and hence is the use of corporeall mortifications, to subject our *Passions* to the beheast of *Reason*) even as when wee see, that when we are in health, our armes, and legs, and all our limbes, obey our will, reaching what we command them, and carrying us whither we desire, because the spirits which are sent into them from our braine, are strong enough to raise and move them as they are directed; but if our sinewes be so steeped in some cold and watry humour, that the spirits coming downe, find not means to swell and harden them; well we may wish and strive, but all in vain: for we shall not be able to make them perform their due functions. In like manner, if *reason* doe send her emissaries into the same arm or leg or other member, and no other spirits doe there strive against them, then that limb is moved and governed absolutely according to her directions: but if at the same time, a greater multitude of others, do hinder *Reasons* servants from coming thither, or flocking into other sinews, doe carry that limb a contrary way; in vain doth *Reason* strive to move them to her byas; for those obeying parts must observe the rules which the violent conqueror prescribeth.

## THE FIFT CHAPTER.

*Containing proofes out of our ſingular apprehenſions, that our ſoule is incorporeall.*

1. The connection of the ſubſequent chapters with the precedent.

AS in our firſt Treatiſe we diſſected nature, and ſhewed, how out of the notion and firſt diviſion of Quantity, ariſeth that vaſt multiplicity of things, which filling this world, falleth under the conſideration of our ſenſes: ſo in the beginning of this ſecond Treatiſe, we have ſearched into thoſe operations of a man (attributed to his ſoule) by which he is conceived to excell all other living creatures: and there diſcovered, that the admirable, and unlimited variety of works, which is ſeen in mens writings and actions, doth all flow from the ſource of *ſingle apprehenſions*; and even from one bare notion of *Being*: which is the root and principle, from whence all others derive their origine; and into which all may be reſolved; works proceeding from reſolutions, they from diſcourſes, theſe being compoſed of judgements, and judgements of ſingle apprehenſions. This part we muſt now review, and enquire what we can find in mans operation, arguing the *Quality* of his Soul, whether it be corporeall or no. For if theſe ſingle apprehenſions, and the proceſſes compounded of them, may be performed by the ordering of rare and denſe parts (as the other works of nature are) then they will be corporeall, and of the ſame kind with thoſe, which we opened in the firſt Treatiſe: but if we ſhall prove, that they cannot poſſibly be deduced from multiplicity, and order of Quantitative parts, when we may confidently reſolve our ſelves, that in the cauſe from which they flow, is a nature wholly diſcrepant from that which reſideth among bodies, and among corporeall things.

This we ſhall here labour to doe: and to that end, we will begin our work with reflecting upon what we have delivered of a ſingle apprehenſion, in the firſt Chapter of this ſecond Treatiſe: whoſe nature we there firſt explicated in common; and thence proceeded to ſome particular apprehenſions; and laſtly ſhewed the extent they comprehended. Theſe then muſt be the ſubject of our preſent ſpeculation.

As

2. The inexistence of corporeall things in the soule by the power of apprehension, doth prove her to be immateriall.

As for their nature, we may remember, how we resolved three things: first, that by apprehension, the very thing apprehended is by it selfe in our soule: next, that the notion of *Being*, is the first of all notions, and is resumed in all others: and thirdly, that what is added to the notion of *Being*, is but *respects* to other things. Now then let us consider, what kind of Engines they must be, that may have the power to make things themselves to be in our soule, if they were to bee there materially? How shall the place, or the time passed, be removed, and be put in another place, and in another time? How shall the quantity of the heavens, of the whole world, nay of bigness exceeding all that by millions of proportionall encreases, be shut up in the little circuite of mans braine? And if we examine our selves strictly, we shall find nothing wanting; all is there. How shall the same thing, bee corporeally in two, nay in two thousand places, at the same time? And yet, in so many is the sunne, when two thousand men think of it at once. We must then allow, that things are there immaterially; and consequently, that what receiveth them, is immateriall: since every thing is received according to the measure and nature of what receiveth it.

But I easily conceive, that the strangeness and incredibility of our position, may counterballance the force of it: for who can perswade himselfe, that the very thing he apprehendeth, is in his mind? I acknowledge, that if its being there, were to be understood corporeally, it were impossible: but on the other side, who shall consider, that he knoweth the thing he rightly apprehendeth, that it worketh in him, and maketh him work agreeable to its nature, and that all the properties and singularities of it may bee displayed by what is in him, and are as it were unfolded in his mind, hee can neither deny nor doubt, but that it is there in an admirable and spirituall manner. If you aske me how this cometh to passe? And by what artifice, bodies are thus spiritualized? I confesse I shall not bee able to satisfy you: but must answer, that it is done, I know not how, by the power of the soule: shew me a soule, and I will tell you how it worketh: but as we are sure there is a soule, (that is to say, a *Principle* from whence these operations spring) though we cannot see it: so we may, and doe certainly know, that this mystery is as we say; though becaus we understand not the true and compleat na-

nature of a ſoule, we can as litle expreſſe the manner, how it is done by a ſoule. Yet, before we take our leave of this matter of *Apprehenſions*, we will in due place endeavour to ſay ſomething towards the clearing of this obſcure point.

3. The notion of *being*, which is innate in the ſoule, doth prove the ſame.

Our ſecond conſideration upon the nature of *Apprehenſion*, was, that our primary and maine notion, is of *Being*. This diſcovereth ſome litle glympſe of the nature of the ſoule: for it is manifeſt that ſhe applyeth this notion, as well to no parts, as to parts: which we proved in the firſt Treatiſe, when we ſhewed that we have a particular notion of *ſubſtance*, diſtinct from the notion of *Quantity*; for quantity and parts being the ſame, it followeth that if there be a notion ſuppoſed by quantity, (as in ſubſtance there is) it muſt of neceſſity abſtract from parts: and conſequently, wee may conclude, that the notion of *Being*, which is indifferently applyable either to quantity or to ſubſtance, doth of its owne nature wholly abſtract either from *Parts*, or from no *Parts*. I then inferre: that ſince this notion of *Being*, is the very firſt and virgin notion our ſoule is imbued with or is capable of, and that it is the root of all other notions, and into which ſhee reſolveth every other notion, in ſuch ſort, as when we have ſifted and ſearſed the eſſence of any notion whatſoever, we can diſcover nothing that is deeper then this, or precedent to it, and that it agreeth ſo compleatly with our ſoule, as ſhe ſeemeth to be nothing elſe but *a capacity fitted to Being*, it cannot be denied, but that our ſoule muſt needes have a very neare affinity and reſemblance of nature with it: but it is evident, that *Being* hath not of it ſelfe any parts in it, nor of it ſelfe is capable of diviſion: and therefore it is as evident, that the ſoule which is framed (as it were) by that patterne and Idea, and is fitted for *Being* as for its end, muſt alſo of it ſelfe be voyde of parts, and be incapable of diviſion. For how can parts be fitted to an indiviſible thing? And how can two ſuch different natures ever meet proportionably?

If it be objected, that the very notion of *Being*, from whence wee eſtimate the nature of the ſoule, is accommodable to parts: as for example, wee ſee that ſubſtance is endewed with quantity. We anſwer, that even this doth corroborate our proofe: for ſeeing that the ſubſtances, which our ſenſes are acquainted withall, have parts, and cannot be without parts; and yet neverthe-

leſſe

leſſe in our ſoule, the notion of ſuch ſubſtance is found without parts; it is cleare, that ſuch ſubſtance hath this meerly from our ſoule: and becauſe it hath this indiviſibility from our ſoule, it followeth that our ſoule hath a power and nature to beſtow indiviſibility upon what cometh into her. And ſince it cannot be denyed, but that if any ſubſtance were once exiſtent without parts, it could never after have parts; it is evident, that the nature of the ſoule is incapable of parts, becauſe it is exiſtent without parts. And that it is in ſuch ſort exiſtent, is cleare: for this effect of the ſoules giving indiviſibility unto what ſhee receiveth into her, proceedeth from her as ſhee is exiſtent. Now ſince this notion of *Being*, is of all others the firſt and Originall notion that is in the ſoule, it muſt needs above all others, favour moſt of the proper and genuine nature of the ſoule: in which, and by which, it is what it is, and hath its indiviſibility.

If then it be preſſed; how can ſubſtance (in reality or in things) be accommodated unto Quantity, ſeeing that of it ſelfe it is indiviſible? Wee anſwer, that ſuch ſubſtance, as is the ſubject of *Quantity*, and that hath *Quantity*, is not indiviſible; for ſuch ſubſtance cannot be ſubſiſtent without *Quantity*; and when we frame a notion of it, as being *indiviſible*; is it an effect of the force of our ſoule, that is able to draw a notion out of a thing that hath parts, without drawing the notion of the parts: which ſheweth manifeſtly, that in her there is a power above having of parts: which being in her, argueth her exiſtence to be ſuch.

4. The ſame is proved by the notion of *reſpects*.

Our laſt conſideration upon the nature of apprehenſion, was, how all that is added to the notion of *Being*, is nothing elſe but *reſpects* of one thing to another; and how by theſe *reſpects*, all the things of the world come to be in our ſoule. The evidence we may draw from hence of our ſoules immateriality, will be not a whit leſſe, then either of the two former: for let us caſt our looks over all that commeth into our ſenſes, and ſee if from one end to another, we can meet with ſuch a thing as we call a *reſpect*: it hath neither figure, nor colour, nor ſmell, nor motion, nor taſte, nor touch; it hath no ſimilitude to be drawne out of by meanes of our ſenſes: to be *like*, to be *halfe*, to be *cauſe*, or *effect*, what is it? The things (indeed) that are ſo, have their reſemblances and pictures; but which way ſhould a Painter goe about to

draw a *likeneſſe*? Or to paint a *halfe*, or a *cauſe*, or an *effect*? If we have any underſtanding, we cannot chooſe but underſtand, that theſe notions are extreamly different, from whatſoever cometh in unto us by the mediation of our ſenſes: and then if we reflect, how the whole negotiation of our underſtanding is *in*, and by *reſpects*; muſt it not follow neceſſarily, that our ſoule is of an extreame different nature from our ſenſes, and from our Imagination? Nay, if we look well into this argument, wee ſhall ſee, that whereas *Ariſtotle* pretendeth, that *Nihil eſt in intellectu quod non prius fuit in ſenſu*; this Maxime is ſo farre from being true, (in rigour of the words) that the quite contrary followeth undeniably out of it; to wit, that *Nihil eſt in intellectu quod fuit prius in ſenſu*. Which I doe not ſay to contradict *Ariſtotle* (for his words are true in the meaning he ſpoke them;) but to ſhew, how things are ſo much changed by coming into the underſtanding and into the ſoule, that although on the one ſide, they be the very ſame things, yet on the other ſide there remaineth no likeneſſe at all between them in themſelves as they are in the underſtanding; which is a moſt evident proofe, (when the weight of it is duely conſidered) that the nature of our ſoule, is mainly different from the nature of all corporeall things, that come into our ſenſe.

5. That corporeall things are ſpiritualized in the underſtanding by means of the ſoules working in and by reſpects.

By this which we now come from declaring, the admiration, how corporeall things can be in the ſoule, and how they are ſpiritualized by their own being ſo, will in part be taken away: for reflecting that all the notions of the ſoule, are nothing but the generall notion of a *ſubſtance*, or of a *thing* joyned with ſome particular *reſpect*; if then we conſider, that the reſpects may be ſo ordered, that one reſpect may be included in another, we ſhall ſee, that there maybe ſome one reſpect, which may include all thoſe reſpects that explicate the nature of ſome one thing: and in this caſe, the generall notion of a *thing* coupled with this reſpect, will contain all whatſoever is in the thing: as for example, the notion of a knife, *that it is a thing to cut withall*, includeth (as we have formerly declared) all that belongeth unto a knife. And thus you ſee, how that myſticall phraſe, of corporeall things being ſpiritualized in the ſoule, ſignifieth no more, but that the ſimilitudes which are of them in the ſoule, are *Reſpects*.

6. That the abſtracting of notions from all particular and individuall accidents, doth prove the immateriality of the ſoule.

Thus having collected out of the nature of *Apprehenſion* in common, as much as we conceive needfull in this place to prove

our

our assertion, our next work must be, to try if we can doe the like, by reflecting upon particular *apprehensions*. We considered them of two sorts, calling one kind, *universall* ones; and the other, *collective* ones: in the universall ones, we took notice of two conditions, the *abstraction*, and the *universality* of them: now truly if we had no other evidence, but what will rise from the first of these, that alone would convince and carry the conclusion: for though among corporeall things, the same may be now in one place, now in another, or sometimes have one figure, sometimes another, and still be the same things, as for example wax or water; yet, it is impossible to imagin any bodily thing whatsoever, to be at any time without all kind of figure, or without any place at all, or indifferent to this or to that; and nevertheless, all things whatsoever, when they are universally apprehended by the soule, have this condition in her by reason of their abstraction there, which in themselves is impossible unto them. When we say, water, fire, gold, silver, bread, &c. doe we mean or expresse any determinate figure? If we doe, none but that precise figure, will serve or content us: but it is evident, that of a hundred different ones, any and every one doth alike intirely satisfy us: when we call for mony, if we reflect upon our fansy, peradventure wee shall find there a purse of crowns: nevertheless, if our messenger brings us a purse of pistols, we shall not except against it, as not being what we intended in our mind, because it is not that which was painted in our fansy: it is therefore evident, that our meaning and our fansy were different; for otherwise, nothing would have satisfyed us, but that which was in our fansy. Likewise in the very word (which is the picture of our notion) we see an indifferency; for no dictionary will tell us, that this word *Mony* doth not signify as well pistols as crowns: and accordingly we see, that if our meaning had bin precisely of crowns, we should have blamed our selves for not having named crowns, and not him that brought us pistols, when we spoke to him by the name of mony: and therefore it is most cleare, that our understanding or meaning is not fixed or determined to any one particular; but it is equally indifferent to all: and consequently, that it cannot be like any thing which entreth by the senses; and therefore not corporeall.

7. That the universality of abstracted notions doth prove the same.

The second condition of *Vniversall Apprehensions*, is their *universality* which addeth unto their abstraction, one admirable particularity

cularity, and it is, that they abſtract in ſuch ſort, as to expreſſe at the ſame time even the very thing they abſtract from. How is it poſſible that the ſame thing can be, and not be in the ſame notion? Yet let a man conſider what he meaneth when he ſaith, *every man hath two eyes*, and he ſhall ſee that he expreſſeth nothing, whereby any one man is diſtinguiſhed from another: and yet the force of this word *Every*, doth expreſſe that every man is diſtinguiſhed from another; ſo that in truth, he expreſſeth particularity it ſelfe in common. Now let our ſmarteſt and ingenioueſt adverſary, ſhew or imagine if he can, how this may be done in a picture, or in a ſtatue, or in any reſemblance of a body or bodily thing: but if he can not, let him acknowledge an eminent and ſingular propriety in the ſoule, that is able to doe it.

Let us reflect, that particularity in a body, is a collection of divers qualities and circumſtances; as that it is white, of ſuch a figure, in ſuch a place, in ſuch a time, and an infinitude of ſuch like conditions, conglobated together: then if our ſoul be a body, the expreſſion of the particularity of a body in the ſoul, muſt be a participation in her of ſuch a conglobation, or of ſuch things conglobated. Now let us imagine if we can, how ſuch a participation ſhould be in common, and ſhould abſtract from all colour, all place, and all thoſe things of which the conglobation conſiſteth, adn yet we ſee, that in the ſoul this is done; and he who ſaith *Every man*, doth not expreſſe any colour, place, or time, and nevertheles he doth by ſaying ſo expreſſe, that in every man there is a conglobation of colour, place, and time: for it could not be *Every one*, unles there were ſuch congloba ions to make *Every one*, *one*: & if any conglobation were expreſſed in this term *Every one*, it would not be *Every one*, but only *one alone*. Now if any coordination of parts can unfold and lay open this riddle, I will renounce all Philoſophy & underſtanding.

8. That collective apprehenſions doe prove the ſame.

*Collective apprehenſions* will afford us no meaner teſtimony then the other two, for the ſpirituality of our ſoule: for although it may ſeem unto us, before we reflect throughly on the matter, that we ſee, or otherwiſe diſcern by our ſenſe, the numbers of things; as that the men in the next roome, are three; that the chaires there, are tenne; and the like of other things; yet after due conſideration, we ſhall find, that our eye, or ſenſe telleth us but ſingly of each one, that it is *one*; and ſo runneth over every one of them; keeping them ſtill each by themſelves, under their owne ſeverall

*unities*;

*unities*: but then the understanding commeth, and joyneth under one notion, what the sense kept asunder in so many severall ones, as there are *things*. The notion of *three*, or of *ten*, is not in the *things*, but in our mind; for why three rather then five, or ten rather then twelve, if the matter of which we speak were not determined? and such determination of the matter, is an effect of the understanding. If I had spoken of *things*, as I did of men, or of chaires, there had been more then three or ten: it is then evident, that what determined my speech, made the number be three or tenne.

Againe, we see that the notion of *ten*, is but one notion; for as the name of ten, is but one signe, so it argueth, that there is but one notion, by which it is the signe of ten things. Besides, we see that Arithmetitians doe find out the proprieties and particular nature of any determinate number: and therefore we may conclude, that every number hath a definition, and a peculiar nature of its owne, as it is a number. If then this definition, or nature, or notion of *ten*, be a corporeall one, it is a corporeall similitude of the object. But is it like to any one of the things, or is it like to all the ten? If to any one, then that one will be ten; if it be like to the whole made of ten, then that whole being but one, ten will be just one, and not ten things.

Besides, to be *ten*, doth expresly imply to be *not one*: how then can that be a materiall thing, which by being one representeth many? Seeing that in materiall things, *one* and *many* are opposite, and exclude one another from the same subject? And yet, this notion could not represent many together, but by being one.

Againe, if it be a materiall notion or similitude, it is eyther in an indivisible of the braine, or it is in a divisible part of it: I meane, that the whole essence of the notion be in every part never so little of the braine, or that one part of the essence, be in one part of the braine, and that another part of the essence, be in another part of the brain. If you say, that the whole essence is in every part of the braine, though never so little; you make it impossible that it should be a body; for you make it the likenesse of ten determinate bodies, in an indivisible manner; seeing that what by division groweth not lesse, hath the nature of an indivisible: but if you say, that divers parts of the essence, are in divers parts of

of the braine, then you make it impoſſible that the notion of tenne, ſhould be indiviſible; ſince it ſelfe is compoſed of ſeverall parts.

In a word, tenne things cannot be repreſented materially, but by ten other things: and therefore it is moſt evident, that the ſoule which repreſenteth ten by one thing or notion, doth not repreſent the tenne materially: and conſequently, that her ſelf is immateriall.

What we have now ſaid, will be confirmed by conſidering the termes, *All* and *whole*: for it is cleare, that theſe termes alſo, are of the nature of numbers; but withall, doe expreſſe particularly that no part is wanting. If then the notion of *All* or *whole*, be ſaid to be materiall or quantitative, it muſt be diviſible: but if you divide it, no part remaineth *All* or *whole*: it is not therefore diviſible; and conſequently it is not materiall. And as this argument is manifeſtly applyable to numbers, ſo if we looke into the arguments concerning numbers, you will find all them likewiſe applyable to theſe termes, *All* and *whole*.

9. The operations of the ſoule drawing alwayes from multitude to unity, do prove the ſame.

Out of what hath been hitherto diſcovered, we may gather this note: that it is the nature of the ſoule, to draw from diviſibility, to indiviſibility; from multitude, to unity; from indeterminateneſſe and confuſion, to a clarity and determination: as appeareth evidently in this laſt example of *Collections*; in which, whether we take numbers, or other collective termes, we ſee that throughout their natures doe conſiſt in ſuch a perfect indiviſibility, as no part can be ſeparated without deſtroying the eſſence of the notion: nay, things which in themſelves are many and conſiſt in parts, doe in the mind get an impartible nature; for *ten*, is no longer *ten*, if it be divided: nor *all*, is *all*, if any thing be taken away. In the ſame manner, though Philoſophy teach us, there be neither points in bigneſſe, nor inſtants in motion or time, yet nature maketh us expreſſe all bigneſſe by points, and all time by inſtants; the ſoule ever fixing it ſelfe upon indiviſibility.

And this is the reaſon, why we attribute the nature of ſubſtance to all our notions: if we ſee a thing white, or black, or doe, or ſuffer, or be in a place, or in time; preſently in our apprehenſions we conceive theſe modifications of the thing, like ſubſtances; and accordingly we call them by ſubſtantive names, *Whiteneſſe*, *Action*,

*Action, Vbication, Duration*, &c. Now the reason of this is, because a substance, (that is terminated within it selfe) is a fit and a steady ground for the soule to fixe it selfe upon, whereas these other Appendixes of substance, would not afford her easie footing to build her structures upon, if she considered them as truly they are in themselves: and therefore in her notion, she giveth them the qualities of substance: but withall it happeneth many times, that by her doing thus, if she be not very wary, she is deceived and falleth into grosse errors.

10. The difference betwixt the notion of a thing in our understanding, and the impression that correspondeth to the same thing in our fansie, doth prove the same.

One thing more we must remember to take notice of; and it is, that if we will compare the notions in our understanding, with the signes which beating in our fansie doe beget those notions; we shall find, that these are but barely signes: and doe not in their owne nature expresse, eyther the notions they raise, or the things they are signes of. This is evident in the images of the sounds we call *words*: for it is cleare, they have no likenesse either with the things they signifie, or with the thoughts they beget in us: and we shall find it no lesse true of other images; for example, in the exteriour impressions of sensible *qualities*, which seeme by themselves to be in the understanding; for if we consider the matter well, we shall perceive that we understand nothing more by them, then we doe by meere words; and that to worke, or to discourse out of them, we must seek into the objects, and their definitions; whereof we learne nothing by those first impressions: for it seemeth, that (for example) hot, or red, or sweet, to a man that first feeth, or feeleth, or tasteth them, signifyeth nothing else, but a thing which maketh such an apprehension in his soule, or such a phantasme in his interiour sense; and nevertheless, as yet the man knoweth not that he hath a soule, or an interiour sense; nor doth reflect so farre as to consider, that this motion passeth by his exteriour sense; but his apprehension is immediately carried to the thing without him; and hee imagineth that the impression he feeleth, is in the thing he feeleth; and so hee that should feele himselfe heated by a burning glasse, and were not acquainted with the vertue of such a glasse, would think the glasse were hot: yet certainly, his first apprehension is of the motion made in his fansie, (though he imagineth it elsewhere) which he conceiveth to be the nature of the thing that maketh it. And thus we see that the conversion of the soule, is immediate to a thing without

without the man: which also is the effect of her being fixed to *Existence*; for by reason of that, she still apprehendeth every impression as a *thing*.

But now, whether her apprehension doth include the very impression, which is in the sense or in the fansie, so that by its own likenesse it be in the soule, or whether the impression in the fansie maketh a change in the soule, which we cannot discerne in it selfe, but conceive it to be the impression which is in the fansie, because that impression is at the first continually present at the said mutation; is more obscure and hard to discover. But when we reflect that after some time, words doe succeed in lieu of this impression, and doe performe the same effect as the originall impression, in what language soever they be uttered, so they be understood; we may conclude out of this evident signe, that the impression is in the understanding not in its owne likenesse, but in another shape, which we doe not discover; and which is excitated, as well by the name, as by the impression, in a man that is used to the names.

Againe, in a man that learneth things by himself, these impressions serve for words, and not for things; for such a man never looketh into his fansie to discourse upon any thing, but onely upon the mutation he conceiveth is made in the externe sense: out of which he gathereth by little and little, the nature of the thing, whose notion was made at first in him by this impression. Out of which it is manifest, that our knowledge is as different a thing, from the Phantasmes which beat at the soules doore, as the thing signifyed is from the sound of the word, or as the wine in the cellar is from the bush: and therefore, it is impossible that the soule (in which that knowledge resideth, and which indeed is that knowledge) should be a corporeall or bodily thing: since of all bodily things, the motions that are made by the sensible qualities, arrive neerest to a spirituall nature.

II. The apprehension of negations and privations do prove the same.

It remaineth now, that we should argue for the immateriality of the soule, out of the extent of our *apprehension*: which seemeth to be so excessive, as not to be comprehensible by the limitations of bodies; and therefore cannot belong unto a body: but because all that needeth to be said in this particular, followeth plainly out of grounds already urged, and that this point containeth not any notable particularity deserving mention here; we will not enlarge

large our selves any further upon it, but will passe on to the next line of operations proper unto our mind.

Only we may not omit taking notice of the expressions which our mind maketh of *nothing*, or as Logitians terme it, of *Negations* and *Privations:* which doe argue an admirable power in the soule, and of a quite different straine from all corporeall things; and doe evidently convince the immateriality of it: for it cannot be doubted, but that the soule knoweth what she meaneth, when she discourseth of *Nothing*. Now if all her knowledge, were nothing else but corporeall phantasmes, or pictures made by corporeall things, how should she come to have a notion of *Nothing?* for since it is most cleare, that *something* cannot be like *Nothing*, and that there cannot be a participation of what *is not*; how can we conceive that there should be a similitude made of *Nothing?*

The way therefore that the soule taketh in this operation, is, that comparing two things together, and finding that the one of them is not the other; she reflecteth upon her owne action, and dividing in it the thing said, from the saying, she taketh the thing said for a quality, or property, or predicate (as Logitians call it) of that thing which she denyeth to be the other thing; and then she giveth it a positive name, after she hath first made a positive notion, unto which the name may agree: as for example, when the soul considereth a man that hath not the power to see, as soon as she hath to her selfe pronounced, that he hath not such a power, she taketh the *not power to see*, for a quality of that man; and then giveth the name of *blindnesse* to that *not power of seeing*; which though of it selfe it be nothing, yet by being that which satisfyeth her act, when she saith that he hath not the power of seeing, it seemeth to be ranked among those things, unto which names are due: for it hath a notion; and the having a notion, is the clayme, or merit, or dignity, in vertue whereof things are preferred to names.

Now then, let us enquire how the power of rarity and density, or the multiplication and order of parts, can be raised and refined to the state of being like *nothing*, or of being the similitude of a *negation*; or what operation of rarity or density, can forge out this notion of *blindnesse*, which we have explicated: and when we find, it is beyond their reach to compasse, we must acknowledge,

ledge, that the ſoule is another kind of engine, then all thoſe which are in the ſtorehouſe of bodies.

## THE SIXT CHAPTER.

*Containing proofes out of our ſoules operations in knowing or deeming any thing, that ſhe is of a ſpirituall nature.*

1. The manner of judging or deeming by apprehending two things to be identified, doth prove the ſoule to be immateriall.

OVr next conſideration ſhall be to ſee what teſtimony our manner of *Iudging*, doth yeeld us of the nature of the ſoule: concerning which, three things offer themſelves, worthy the reflecting on; which are, our manner of thinking; the oppoſition which frequently occurreth in our thoughts; and the nature of truth and of falſhood. As for the firſt, we may remember how we have ſhewed, that all *judgement* or *deeming* is but an apprehenſion of identification, or ſomething immediately following out of it: and that a ſetled *judgement* or *aſſent of the mind* is as it were a limbe, or branch, or graft in our ſoule; ſo that we finde that our perceiving of identification between two things, or our ſeeing that the one is the other, is that by which our ſoule encreaſeth. Now, becauſe when two things are identified, the one reacheth not further then the other, it is clear that this increaſe of the ſoule is not made by parts, which being added one to another do cauſe it to be greater: and therefore, ſince this latter courſe is the only means of increaſe in bodies and in quantity, it is as clear that the nature of the ſoule, is quite different from the nature of all corporeall or Quantitative things.

Againe, it is againſt the nature of identification, to be of parts; and therefore, they who take quantity to be one thing, and not many things tyed together, doe acknowledge that truly there are no parts in it: and this is ſo rigorouſly true, that although wee ſpeak of two things that in reality are identifyed one with another, yet if our words be ſuch, as imply that our underſtanding conſidereth them as diſtinct parts, and by abſtraction giveth them the nature of parts; then they are no longer identifyed, but in good Logick, we ought in this caſe to deny the one of the other. As for example: though the hand and the foot be the ſame thing, (as we have declared in our firſt Treatiſe) yet becauſe in the name

*hand*,

*hand*, there is a ſecret excluſion of any thing that is not in the definition of a hand, it followeth that in our ſpeech we muſt ſay, that a hand is not a foot. Likewiſe though it be confeſſed, that the thing which is *rationality* is alſo *riſibility*; nevertheleſſe, it is a ſoleciſme in Logick, to ſay that *rationality* is *riſibility*; becauſe it is the nature of theſe abſtracted names, to confine their ſignifycations to one definition; and the definitions of theſe two termes are divers. Out of this conſideration it followeth clearly, that ſeeing the nature of parts, is contrary to the nature of identity; and that the ſoule in her judgements worketh altogether by identity, it is impoſſible that her operations ſhould conſiſt of parts, or in any ſort reſemble any proceeding of Quantitative things.

2. The ſame is proved by the manner of apprehending oppoſition in a negative judgment.

The like will be convinced out of the oppoſition we finde in our thoughts. In it we may conſider two things: firſt the generation of it: next, the incompoſſibility of oppoſites in the ſoul. To begin with the firſt: we ſee that in our ſpeaking, oppoſition is produced by the addition of this word *Not*: as when we ſay, *not a man*, *not a penny*, *not a word*: and therefore it followeth, that in our ſoule there is a notion of it, correſpondent to the word that expreſſeth it. Now, ſeeing that a notion is a thing, and that it is the likeneſſe of its object, or rather the ſame with the object: let us caſt about, how we ſhould of parts and of quantity, make a *nothing*, or an identification to *not*: and when we find, that it is ridiculous and abſurd to goe about it, let us conclude, that the manner of working, which our ſoule uſeth, is far different from that which is uſed in bodies, and among materiall things.

And if you object, that not onely a body, but even any other ſubſtance whatſoever (ſuppoſe it as ſpirituall as you will) cannot be either like, or identifyed to *nothing*; and therefore this argument will as well prove that the ſoule is not a thing or ſubſtance, as that it is not a body: we anſwer, that it is evident out of what we have already ſaid, that the underſtanding is not the objects it underſtandeth, by way of ſimilitude, but by a higher meanes; which we have ſhewed to be by way of *Reſpects*. Now then, the reſpect which the thing hath to another thing, by not having ſuch a reſpect unto it, as a third thing formerly conſidered hath thereunto, may be expreſſed in way of *Reſpects*, though it cannot in way of ſimilitude: and ſo our underſtanding is able to expreſſe, what

what neyther our fanſie, nor any corporeall thing can arrive to the expreſſion of: as when firſt we finde, that one man hath a reſpect to the wall, which we call the power of ſeeing it, if afterwards we find that another man hath a reſpect unto the wall of impotence, that he cannot ſee it, this ſecond reſpect the underſtanding hath a power to expreſſe as well as the firſt: as we have touched above.

3. That things in themſelves oppoſite to one an other having no oppoſition in the ſoule, doth prove the ſame.

As for the oppoſition that occurreth in our thoughts, we may conſider it of two kinds: the one is of the things or objects that come into our thoughts or into our ſoule and this is not properly an oppoſition in the ſoule; for although the things be oppoſite by their owne nature in themſelves, yet they doe not exerciſe their oppoſition in the ſoule: nay, though the oppoſition be even in the ſoule it ſelfe, if the ſoule with this oppoſition, be conſidered as an object, it maketh no oppoſition in the ſoule; for ſo you may conſider your ſoul learned and unlearned, ignorant & knowing, good and bad, and the like: all which are oppoſitions in a ſoule ſuppoſed to be ſo qualifyed, but are no oppoſitions in a ſoule that conſidereth them: no more then fire and water, heavy things and light, white and black, being and not being, an affirmative propoſition and its negative, and the like: all which are in themſelves ſo contrary and oppoſite to one another, that they cannot conſiſt together in one ſubject; they have an incompoſſibility among themſelves, whereſoever the one of them is, by its very entrance it driveth out its oppoſite: and yet in the ſoul they agree together without reluctance: ſhe knoweth and conſidereth and weigheth both ſides of the ſcale at the ſame time, and ballanceth them evenly one againſt another: for unleſſe both the oppoſites were in the ſame inſtant in the ſame comparing power, that power could not by one act whoſe beginning implyeth its ending, judge the difference and oppoſition of them: as when we ſay *black is contrary to white*, or *darkneſſe is the want of light*, we pronounce one common *not being* of both extremes.

We may then boldly conclude, that ſince no body whatſoever can entertaine at the ſame time, and in the ſame place, theſe quarrelling Antagoniſts, but that by their conflict, they preſently deſtroy one another, and peradventure the body too, into which they preſſe for entrance, and the entire poſſeſſion of which each of them ſtriveth for; (thoſe of them I meane, that are proportioned

tioned to the reception of bodies) and that the ſoule imbibeth them together without any difficulty or contraſt, and preſerveth them alwayes friends even in the face of one another, and lodgeth them together in the ſame bed; and that (in a word) theſe oppoſite things doe enjoy an admirable and unknowne manner of *Being* in the ſoule, and which hath no parallel nor argument in bodily things: wee may (I ſay) boldly conclude, that the ſoule it ſelfe, in which all theſe are, is of a nature, and hath a manner of *Being* altogether unlike the nature of bodies, and their manner of *Being*.

4. That the firſt truths are identified to the ſoule.

Out of this agreeing of all objects in the ſoule, and their having no oppoſition there, even whiles ſhee knoweth the oppoſition that is between them in themſelves, there followeth another conſideration, of no leſſe importance: which is, that the amplitude of our ſoule in reſpect of knowledge, is abſolutely infinite; that is to ſay, ſhee is capable of knowing at the ſame time objects without end or meaſure. For the explicating whereof, we are to conſider, that the latter concluſions, which the ſoul gaineth knowledge of, doe hang to the former by identification, or by the ſoules ſeeing that two notions are identified, becauſe they are identified to a third, as is before expreſſed; and the firſt principles which ſeem to be immediately joyned unto the the ſoule, have the identity of their termes plaine and evident, even in the very termes themſelves. Nay, if we inſiſt further, wee ſhall find that the firſt truths muſt have an identification to the very ſoule it ſelfe; for it being evident that truth or falſhood, is not in the ſoule but ſo farre forth, as ſhe doth apply her ſelfe to the externall object, or to the exiſtence of things in themſelves; and that we find that the ſoules knowing with evidence that any thing *is* or *hath being*, implyeth her knowing that her ſelfe *is*; (for ſhee cannot know that a thing ſeemeth ſo to her, or maketh ſuch an impreſſion in her, without knowing that her ſelfe *is*; though peradventure ſhe may not know what her ſelfe is, but taketh her ſelfe to bee no other thing then the body of the man in which ſhee is) it is evident that the firſt truths which enter into the ſoule, to wit, that this or that ſeemeth ſo or ſo unto her, (and theſe truthes no ſcepticke ever doubted of) are identifyed with the ſoule it ſelfe; ſeeing that an

object seeming to be such or such, is nothing else, but the soule is so qualified.

And in this we find, that the certainty of the first *Principles*, as for example of this Proposition, *That the whole is bigger then the Part*, will depend in a particular soule of her certainty of her owne *Being*: for although this Proposition would have a necessity in the very connexion of the termes, notwithstanding there were not in nature any *whole* or *Part*; yet this necessity would not be a necessity of *Existence* or of *Being* in the object, but a necessity of connexion, as it were of two parts of the soule: and so, if verity and falsity be not perfectly in the soule, but in the comparison to actuall existence, the soule would not be perfectly true, or (to say more properly) would not have the perfection of truth in her, by having or knowing this Proposition, unlesse withall she were certain, that there were existent, an object of this Proposition: of which (as we have said) she cannot be certain, without being certain of her owne *Being*; so that in effect, the identification of other things among themselves, by which such things are knowne, doth come at the last to be retrived in the existence of the soule it selfe, and to be in the soule, by the identification of those other things unto her selfe.

5. That the soule hath an infinite capacity, and consequently is immateriall.

Now then to proceed to the proofe of our proposed conclusion, it is cleare, that the adding of one thing to another, doth out of the force of this addition, perfect the thing unto which the addition is made, if the advenient thing be added in such way, as the former is apt to receive it: but it is evident, that the soule is made fit by former Propositions, to be identifyed to latter ones; for wee see that the former ones draw on, and inferre the latter ones: and therefore it followeth, that the more is added to the soule, the greater is her aptitude to have more, or to bee more encreased: and consequently, that the more is added unto her, the more may still bee added; and the more capable and more earnest shee is, to have more. Wherefore it cannot be denyed, but that since in the nature of the objects there is no impediment to hinder their being together in the soule, (as wee have proved a little above) and that in her by receiving new objects into her, there is a continuall encrease of capacity to receive more; shee hath an amplitude to knowledge absolutely

absolutely infinite, in such a manner as we have above expressed.

Now to apply to our purpose what we have gathered by this discourse, it is cleare, that these two conditions of *one thing not driving out another*, and of *infinity of accessions*, doe openly disclaime from quantity, and from matter; for we see that what hath Quantity, or is a body, cannot admit a new thing into it, unlesse some other thing doe first goe out of it, to make roome for the advenient one: and as for infinitude, it breedeth a sea of contradictions, if it be but thought of in Quantity: and therefore we may conclude, that the soul, unto whom these two conditions doe belong, is not quantitative or corporeall, but immateriall, and of a spirituall nature.

6. That the opposition of contradictory Propositions in the Soule doth prove her immateriality.

The second kind of opposition, that occurreth in our thoughts, or in our soule, is of *Contradictory Propositions*: it hath its origine in the opposition of *Being* to not *Being*: and is when a thing is identifyed unto the soule, in such sort as we have said, that a *Iudgment* or *Deeming* maketh the object become as it were a limbe, or part of the soule: and because the conflict of two such Propositions, if they were together in the soule, would make her bee something contrary to the nature of *Being* (if any thing can *bee* contrary to *Being*) which in the schooles they call *ens & non ens*; the impossibility of her admitting into her selfe two such Propositions together, doth testify her firme cleaving and her fixednesse to *Being*: and so doth confirme and bring new evidence to that argument for the soules spirituality, which in the fifth Chapter of this part, we drew from the nature of *Being*.

As for truth and falshood, they spring from the same root as the last; as being qualities consequent to the opposition of affirmative and negative Propositions; whereof if the one be true, the other must necessarily be false: and therefore, we need not spend time in setting down any particular considerations of these; since what we have said of the other, is applyable unto them: but it is sufficient, that we thus note them, to give the Reader occasion to reflect upon them.

7. How Propositions of *eternall truth*, doe prove the immateriality of the soule.

Among Propositions, there are some which Logitians doe term *of Eternall truth*: and out of these, there are ingenious men, who imagine that the immortality of the soule may be immediately deduced. Herein they rove not quite from the marke; though withall

withall I must needs say, they doe not directly hit it. To understand the utmost that may be inferred out of such Propositions, we may note two conditions in them: the first is, that generally these Propositions are universall ones; and thereby have that force to convince the spirituality of the soule, which we have explicated and shewed to belong unto universall termes: the second is, that in these Propositions, there is a necessity of connexion between their termes; such an one, or at the least very like thereunto, as we explicated in those Propositions, which beare their evidence plaine in their very termes. And out of this wee may draw another argument for the spirituality of the soule: for wee see that all corporeall agents and patients, are defectible and contingent; that is to say, sometimes, or if (if you will) most times, they attaine their effect; but withall, sometimes (be it never so seldome) they misse of it: and accordingly, it happeneth sometimes that our eyes, our eares, our touch, and the rest of our senses are deceived; though for the most part, they give us true informations of what they converse with: but these Propositions of eternall verity doe never faile: they have in themselves an indefectibility insuperable; and consequently, they give evidence that the soules nature is of a higher degree of constancy and certainty, then what falleth within the compasse of bodies: and is of a nobler and different straine, from all corporeall things: for this certainty is entayled upon such Propositions by the force of *Being*; which is the proper object of the soule: and they have their *Being*; as limbes and parts of the soule.

As for the terme of *Eternall verity*, it is not to be taken positively, as if these Propositions, or their objects, had any true eternity or perseverance, without beginning or ending: but only negatively; that is, that there can be no time, in which they are false: and therefore, we cannot out of their having such a kind of Eternity belonging to them, argue a capacity of infinite time or duration in our soule that comprehendeth them.

THE

## THE SEVENTH CHAPTER.

*That our discoursing doth prove our soule to bee incorporeall.*

HAving thus runne over those proofes for the immateriality of our soule, which arise out of her manner of working when shee judgeth; in the next place, wee are to enquire what others, her manner of discoursing will afford us. Wee are sure, that since our discourse is composed of judgements, and of single apprehensions, it cannot choose but furnish us with all those pregnant arguments, that wee drew from them. But that will not serve our turne: wee look after new evidence: and wee shall see it will give it us with full hands. It consisteth in this: that when wee discourse, wee may easily perceive there is more at one time in our mind, then we can discover to be in our fantasie; for we find, that in our fantasie, as one Proposition commeth, another is gone: and although they that are gone, seeme to bee ready at a call, yet they are not in presence; as being things which consist in motion, and that require place; and therefore the one justleth the other out of the place it possessed. But if it fared in like manner in our inward soule, we could never attain unto knowledge: for it is manifest, that our soule is not assured of a conclusion, but by her seeing the premisses: if then the premisses be taken away, the conclusion that resteth upon them, falleth to the ground: but they are taken away, if they be out of our mind: therefore, when our understanding yeeldeth its assent to a conclusion, it must of necessity have the premisses still in it.

1. That in discoursing the soul containeth more in it at the same time then is in the fantasie, which proveth her to be immateriall.

But we must not rest here; this consideration will carry us on a wonderous deale further: wee know, that who so goeth to frame a new demonstration in any subject, must be certain he taketh nothing contrary to what he hath learned in many bookes: likewise, that who will make a latine verse, or readeth a Poeme, knoweth there is nothing in all that Poeme contrary to his Prosodia: doe we not then manifestly perceive a certaine remainder of all these in his soule? The like is in all arts: in which he

that goeth about any work according to art, ſheweth hee hath in his head all the rules of that art, though he doe not diſtinctly remember them, or call them to mind whiles he worketh: for if he have them not, how doth he work by them? Since then it is cleare that he thinketh not of them at that time, it is as cleare, that more is in the ſoule at one time, then is in his fantaſie, or then can be there by materiall bodies, (which wee have ſhewed is the way, whereby all things come into the fantaſie) although it be the nimbleſt and the ſubtileſt Agent of all corporeall things whatſoever.

2. That the nature of diſcourſe doth prove the ſoule to be ordered to infinite knowledge, and conſequently to be immateriall.

Another conſideration whereby to evince the immateriality of the ſoule, concerneth the proceeding of ſyllogiſmes by linkes, faſtned one to another: whence we may take notice, that every one of them is a ſtep to another: and conſequently, it is manifeſt that according to the nature of the ſoule, they muſt bee altogether in her: ſince, if any one were abſent, all the reſt that followed and depended upon that one, would have no grounding, nor fixedneſſe in the ſoule. Now if to this we adde, that what is to be knowne, is abſolutely and liquidly infinite, there cannot be brought or expected a more pregnant and home-witneſſe of our ſoules ſpirituality: it following out of theſe grounds; that the ſoule by its nature, is not only capable of, but is expreſſely ordered to an infinite knowledge of infinite objects altogether; for theſe two, *finite* and *infinite* ſcience, are ſo vaſtly different from one another, that if the ſame ſubject bee capable of both, it muſt of neceſſity be ordered to infinite, as to its chiefeſt act and end: and thus out of *capacity* in this ſubject, *its being ordered* is well inferred; though in other matters peradventure the conſequence may not be good. And accordingly who looketh into *Geometry*, *Arithmeticke*, *Logicke*, or even *nature* it ſelfe, will evidently ſee that the objects of knowledge, are every way, and in every ſcience, multiplyable without end.

3. That the moſt naturall objects of the ſoul are immateriall, and conſequently the ſoule her ſelfe is ſuch.

Neither ought this to bee neglected, that a great part of the ſoules objects, and indeed of thoſe that are moſt naturall to her, is above the capacity, and out of the reach of materiall things. All Metaphyſicks abſtract from quantity: the inveſtigation of God, of Angels, of the ſoule it ſelfe, either concludeth immateriality, or at the leaſt worketh about it.

What

What ſhall I ſay of Logicall notions, of thoſe which are called the *ſecond intentions*; about which there is ſo much buſineſſe both in the ſchooles and in the world? It is ſufficient that wee have already expreſſed, how all our notions are *reſpective*. But in particular the motives of humane actions are very abſtracted conſiderations: as for example, hope of things to come, memory of things paſſed, vertue, vice, honour, ſhame, and the like. To theſe let us adde, that when wee teach or explicate any thing to ignorant perſons, we muſt frame our owne apprehenſions to their capacity, and wee muſt ſpeak ſuch things as they may comprehend: which capacity or extent of comprehenſion wee cannot ſee nor perceive by any ſenſe, but wee judge it meerely by our Reaſon, and by our underſtanding. Wherefore, ſeeing that our operation is mainely and chiefly on and by ſuch motives, as are not lyable to materiall principles and compoſitions, it is evident, that the ſpring-head from whence ſuch an operation floweth, muſt alſo bee immateriall and incorporeall.

I am not ignorant, that this argument uſeth to be anſwered by urging, that the ſoule likewiſe knoweth *Deafeneſſe*, *Dumbneſſe*, *Blindneſſe*, and ſuch other notions of *Nothings*; and yet is not from thence inferred to be *nothing*: it conceiveth God and Eternity; and yet it is neither from it ſelfe, as God is, nor eternall. In like manner (ſay they) it may know incorporeall things, and yet not be therefore it ſelfe incorporeall. To this I reply, firſt wiſhing them not to miſtake me, but to give my argument its full force and weight: for there is a very great difference between the knowing of a thing, in a ſtrained, toyleſome, and confuſed manner, and the having a thing for its ordinary matter and ſubject of negotiation: this argueth connaturality between the ſoule and what it is in ſuch ſort converſant about; but that doth not. Now what is inferred out of whole ſciences and arts, concerneth a maine ſtock of the ſoules buſineſſe, and not ſome extraordinary vertue or powers ſhe hath.

But to come up to cloſe to the anſwer: I ſay, that if wee being throughly acquainted with materiall things, can find that it is not in the poſſibility of any ſuch to be the likeneſſe of an immateriall thing; and from thence doe inferre that our ſoule, for being

fraught with immateriall notions, is not materiall; our concluſion is well collected, and a very good one; for the premiſſes out of which we doe gather it, are within our kenning; and therefore if there were any defect in the conſequence, wee ſhould eaſily perceive it. Whence it appeareth clearly, that there is no parity between the deduction of our concluſion, and that other which the objection urgeth, that our ſoule, becauſe it can know eternall things, is alſo eternall; for eternity is a thing beyond our comprehenſion: and therefore it ought ought not to be expected at our hands, that we ſhould be able to give an account where the brack is. And to ſay the truth, if *knowledge* be taken properly, we doe not know eternity; however by ſupernaturall helps we may come to know it: but in that caſe, the helps are likely to bee proportianable to the effect. Neither are negations properly knowne, ſeeing there is nothing to bee knowne of them. And thus we ſee that theſe objections doe proceed from the equivocation of the word *knowledge*; ſometimes uſed properly, othertimes applyed abuſively.

## THE EIGHT CHAPTER.

*Containing proofes out of our manner of proceeding in action, that our ſoule is incorporeall.*

1. That the ſoules being a power to order things proveth her to be immateriall.

I Doubt not but what we have already ſaid, hath ſufficiently convinced our ſoules being immateriall, unto whomſoever is able to penetrate the force of the arguments wee have brought for proofe thereof, and will take the paines to conſider them them duely: (which muſt bee done, by ſerious and continued reflection, and not by curſary reading, or by interrupted attempts) yet ſince wee have ſtill a whole field of proofes untouched, and that in ſo important a matter, no evidence can be too clear, nor any paines be accounted loſt, that may redouble the light, although it ſhine already bright enough to diſcern what we ſeek, we will make up the concert of unanimous teſtimonies to this already eſtabliſhed truth, by adding thoſe arguments wee ſhall collect out of the manner of our ſoules proceeding to action, unto

unto the others we have drawn from our obſervations unto her apprehenſions, her judgements, and her diſcourſes.

Looking then into this matter: the firſt conſideration we meet withall is, that our underſtanding is in her owne nature an *orderer*; and that her proper work is to rank and put things in order: for if we reflect upon the workes and arts of men, as, a good life, a common-wealth, an army, a houſe, a garden, all artefacts; what are they, but compoſitions of well ordered parts? And in every kind, we ſee that he is the Maſter, and the Architect, and is accounted the wiſeſt, and to have the beſt underſtanding, who can beſt, or moſt, or further then his fellowes, ſet things in order. If then to this we joyne, that Quantity is a thing whoſe nature conſiſteth in a capacity of having parts and multitude, and conſequently is the ſubject of ordering and ranking; doth it not evidently follow, that our ſoule, compared to the whole maſſe of bodies, and to the very nature of corporeity or quantity, is as a proper agent to its proper matter to worke upon? Which if it be, it muſt neceſſarily be of a nobler ſtraine, and of a different and higher nature then it; and conſequently, cannot be a body, or be compoſed of Quantity: for had it matter in it ſelfe, what it expecteth and requireth from the agent, it would not need the agents help, but of it ſelfe it were fit to be an Agent. Wherefore if the nature of corporeity, or of body, in its full latitude, be *to be ordered*, it followeth that the thing whoſe nature is to be an *orderer*, muſt as it is ſuch, be not a body, but of a ſuperiour nature, and exceeding a Body: which we expreſſe by calling it a *ſpirituall thing*.

2. That the ſoules being able to move without being moved, doth prove her to be immateriall.

Well then, if the ſoule be *an orderer*, two things belong neceſſarily unto her: The one is, that ſhe have this order within her ſelfe; the other is, that ſhe have power to communicate it unto ſuch things, as are to be ordered. The firſt ſhe hath by ſcience, of which enough already hath been ſaid towards proving our intent. Next, that her nature is communicative of this order, is evident out of her action and manner of working. But whether of her ſelfe ſhe be thus communicative, or be ſo by her conjunction to the body ſhe informeth, appeareth not from thence. But where Experience falleth ſhort, Reaſon ſupplyeth, and ſheweth us that of her owne nature ſhe is communicative of order; for

for seeing that her action is an *ordering*, and that in this line there are but two sorts of things in the world, namely, such as do order, and such as are to be ordered; it is manifest, that the action must by nature and in the universall consideration of it, begin from the *orderer* (in whom order hath its life and subsistence) and not from that which is to receive it: then, sithence *ordering* is motion, it followeth evidently that the soule is a mover and a beginner of motion.

But since we may conceive two sorts of movers; the one when the agent is moved to move; the other, when of it selfe it beginneth the motion without being moved; we are to enquire, unto which of these two the soule belongeth. But to apprehend the question rightly, we will illustrate it by an example: let us suppose that some action is fit to begin at ten of the clock: now we may imagine an agent to begin this action in two different manners; the one, that the clock striking ten, breedeth or stirreth somewhat in him, from whence this action followeth; The other manner is, that the agent may of his own nature, have such an actuall comprehension or decurrence of time within himselfe, as that without receiving any warning from abroad, but as though he moved and ordered the clock as well as his owne instruments, he may of himselfe be fit and ready, just at that houre to begin that action; not as if the clock told him what houre it is, but as if he by governing the clock, made that houre to be, as well as he causeth the action to begin at that houre. In the first of these manners, the agent is moved to move; but in the second, he moveth of himselfe, without being moved by any thing else. And in this second way, our soule of her owne nature communicateth her selfe to quantitative things, and giveth them motion: which followeth out of what we have already proved, that a soule, in her owne nature, is the subject of an infinite knowledge, and therefore is capable of having such a generall comprehension, as well of time, and of the course of all other things, as of the particular action she is to doe; and consequently, standeth not in need of a Monitor without her, to direct her when to begin.

If then it be an imprevaricable law with all bodies, that none whatsoever can move unlesse it bee moved by another; it

it followeth, that the ſoule which moveth, without being ſtirred or excitated by any thing elſe, is of a higher race then they; and conſequently is immateriall and voyd of Quantity. But let me not bee miſtaken in what I come from ſaying; as though my meaning were, that the ſoule exerciſeth this way of moving her ſelfe, and of ordering her actions, whiles ſhee is in the body: for how can ſhee, ſeeing ſhe is never endewed with compleate knowledge requiſite for any action; never fully comprehending all the circumſtances of it? But what I intend, is that the nature of the ſoule, conſidered in it ſelfe, is ſuch, as hath a capacity and may reach to this manner of working, (whence I inferre that ſhee is not a body but a ſpirit) without determining, whether ſhe worke thus in the body, or out of it: that enquiry belongeth not to this place; it will follow by and by.

5. That the ſoules proceeding to action with an univerſality, & indifferency, doth prove the ſame.

But for the preſent, having conſidered unto what kind of working, the nature of the ſoule in abſtract, is capable of attaining; we will conclude this Chapter with reflecting upon thoſe actions of hers, which fall daily under our remarke, as being exerciſed in the body. In all of them we may obſerve, that ſhe proceedeth with a certaine univerſality and indifferency, beyond the practice of all other creatures whatſoever. For example, if a man be ſpoken to, or asked of a hundred ſeverall things that he never thought of before in all his life, he will immediately ſhape pertinent replyes, to all that is ſaid, and returne fitting anſwers to every queſtion: As, *Whither ſuch a man goeth? How long this ſtaffe is? What colour that mans clothes are of? &c.* To all which, and to as many things more as you will, (ſo they be within the compaſſe of his knowledge) he ſtraight anſwereth differently, and to the purpoſe. Whence it is manifeſt, that his anſwers doe not proceed upon ſet gimals or ſtrings, whereof one being ſtruck, it moveth the reſt in a ſet order, (which we have ſhewed, is the courſe in all actions done by beaſts) but out of a principle within him, which of it ſelfe is indifferent to all things; and therefore can readily apply it ſelfe to the anſwer, according as by the queſtion it is moved: and the like may be obſerved in his actions; which he varyeth according to the occaſions preſented.

I remember how Sir *Philip Sidney* (the Phœnix of the age he lived in, and the glory of our nation, and the patterne to posterity of a compleat, a gallant, and a perfect Gentleman) aptly calleth our hands, the instruments of instruments; from *Aristotle*, who termeth them *Organa organorum*, or universall instruments, fitly moulded to be employed in any service; whereas nature hath to all other creatures appropriated their instruments to determinate actions, but to man, she hath (in these) given such, as might be applyed to any kind of work whatsoever: and accordingly we see, that the same kind of bird, still buildeth her nest, and breedeth her young ones, in the same way, without any the least variance at all: but men do build their houses as they please, sometimes upon hils, sometimes in vales, sometimes under the earth, and sometimes upon the tops of trees: and the manners of breeding or instructing their children, are as divers, as the customes of nations and townes: and in all other actions, our Masters note it for a property peculiar to Man, that hee useth to arrive unto the same end by divers means, as to transport ourselves unto some place wee would goe unto, eyther by water, or by horse, or by coach, or by litter, as we please: whereas we see no such variety in like actions of other living creatures.

All which being so, we may conclude, that the soules proceeding either to answers, or to action, argueth cleerly that shee hath within her selfe such an indifferencie, as is joyned with a meanes to determine this indifferencie: the contrary whereof we see in all corporeall engines; for they have every step in the whole course of their wayes, chalked out unto them, by their very framing, (as hath been amply declared in the first Treatise) and have the determination of their worke, from end to end set downe, and given them by their artificier and maker: and therefore it is most evident, that the soule cannot be a thing composed or framed of materiall and quantitative parts, seeing shee hath not her wayes set downe unto her, but frameth them of her selfe, according to the accidents that occur.

4. That the quiet proceeding of reason doth prove the same.

The same nature of the soule, discovereth it selfe in the quiet proceeding of *Reason*, when it worketh with greatest strength and vigour; as well knowing, that its efficaciousnesse consisteth not

not in the multitude of parts, which *Passion* breedeth, but in the wel ordering of those it already hath under its command. Whereas the strength of Quantity, and the encrease of its strength, consisteth in the multitude of its parts; as will evidently appeare to whom shall consider this point deeply.

5. A conclusion of what hath been said hitherto in this second treatise.

Thus we have in a summary manner gone through all the operations of the soule, which in the beginning of this latter Treatise, we heaped together as materials, wherewith to raise an immateriall and spirituall building. Neither, I hope, will our Reader be offended with us, for being more succinct and concise in all our discourse concerning our soule, then where wee delivered the doctrine of Bodies: for the difficultnesse of this subject, and the nicety required to the expressing our conceptions concerning it, wherein (as the proverb is) a haire is to be cloven, would not allow us that liberty of ranging about, as when we treated of Bodies. What occurreth among them, may be illustrated by examples within their owne orbe, and of their owne pitch; but to display the operations of a soule, we can finde no instances that are able to reach them; they would rather embroile and darken them: for the exact propriety of words, must be strictly and rigorously observed in them: and the Reader shall penetrate more into the nature and depth of them, by serious meditation and reflection upon the hints we have here given, (efficacious enough, I hope, to excite those thoughts he should have for this purpose, and to steere them the right way) then by much and voluminous reading, or by hearing long and polished discourses of this subject.

For my part, if what I have here said, should to any man appeare not sufficient to convince that our soule is of a spirituall and far different nature, from all such things as in our first Treatise we have discoursed upon, and taken for the heads and most generall kinds of Bodies, (unto which all other particular ones, and their motions may be reduced) I shall become a suitor to him, in entreating him to take this subject into his handling, where it beginneth to be unwieldy for mine, and to declare unto us, upon the principles we have setled in the first Treatise, and upon considering the nature of a body, (which is the first of all our notions) how these particulars wee have reflected upon in

mans

mans actions, can be drawne out of them; for I can finde no possible meanes to linke them together: a vast and impenetrable Ocean, lyeth betweene the discoveries we have made on each side of its shores, which forbiddeth all commerce between them; at the least, on the darke bodies side, which hath not wings to soare into the region of *Intellectuall* light. By those principles, we have traced out the course and progresse of all operations belonging to sense; and how beasts doe or may performe all their actions, even to their most refined and subtilest operations: but beyond them, we have not been able to carry these grounds, nor they us. Let him then take the pains to shew us, by what figures, by what first qualities, by what mixtion of rare and dense parts, an universall apprehension, an evident judgement, a legitimate consequence is made: and so of the like; as, of a mans determination of himselfe to answer pertinently any question; of his choosing this way before that, &c. Which if he can doe (as I am sure he cannot) I shall allow it to be reason, and not obstinacie, that worketh in his mind, and carryeth him against our doctrine: but if he cannot, and that there is no apparance nor possibility (as indeed there is not) that these actions can be effected by the ordering of materiall parts, and yet he will be still unsatisfyed, without being able to tell why, (for he will be unwilling to acknowledge, that these abstracted speculations, doe not sinke into him, and that nothing can convince him, but what his senses may be judges of, and that he may handle, and turne on every side like a brick or a tile) and will be still importune with cavillous scruples, and wild doubts, that in truth, and at the bottome doe signifie nothing, we will leave him to meditate at his leisure upon what we have said; whiles we proceed on to what followeth out of this great principle, *That our soule is incorporeall and spirituall.*

THE

## THE NINTH CHAPTER.

### *That our Soule is a* Subſtance, *and* Immortall.

HAving concluded that our Soule is immateriall and indiviſible; to proceed one ſtep further, it cannot be denyed, but that it is either a ſubſtance or an accident; if the latter, it muſt be of the nature of the ſubſtance whoſe accident it is; for ſo we ſee all accidents are: but in man when his ſoule is excluded, there is no ſpirituall ſubſtance at all, whereof we have any notice: and therefore if it be an accident, it muſt be a corporeall accident, or ſome accident of a body; as ſome figure, temperature, harmony, or the like: and conſequently, it muſt be diviſible: but this is contrary to what is proved in the former Chapters: and therefore it cannot be a corporeall accident. Neither can it be a ſpirituall accident; for unto what ſpirituall ſubſtance ſhould it belong, when as nothing in man can be ſuſpected to be ſpirituall, but it ſelfe. Seeing then that it can be no accident, a ſubſtance it muſt be, and muſt have its *Exiſtence* or *Being* in it ſelfe.

1. That Mans Soule is a ſubſtance.

Here we have paſſed the Rubicon of experimentall knowledg: we are now out of the bounds that experience hath any juriſdiction over: and from henceforth, we muſt in all our ſearches and concluſions relie onely upon the ſingle evidence of Reaſon. And even this laſt concluſion we have been faine to deduce out of the force of abſtracted reaſoning upon what we had gathered before; not by immediate reflection upon ſome action we obſerve proceeding from a man: yet withall, nature flaſheth out by a direct beame, ſome little glimmering of the verity of it, to the eye of Reaſon that is within us: for as when we ſee a clock move, or a mill, or any thing that goeth by many wheels, if we mark that there are two contrary motions, in two divers parts of it, we cānot think that thoſe contrary motions, do belong to one and the ſame continued body, but ſhall preſently conclude, that there muſt be in that engine two ſeverall bodies compacted together; ſo in man, though his body be the firſt mover that appeareth unto us, yet ſeeing that in his actions, ſome effects doe ſhew themſelves, which

2. That Man is compounded of ſome other ſubſtance beſides his body.

which it is impossible should proceed from a body, it is evident, that in him there is some other thing besides that one which we see: and consequently we may conclude, that he is composed of a body and of somewhat else that is not a body: which *somewhat else*, being the spring from whence those actions flow, that are of a different straine from them that are derived from the body, must necessarily be a spirituall substance.

3. That the soule doth subsist of it selfe independently of the body.

But whiles we are examining, how far our present considerations, and short discourses may carry us, as it were experimentally to confirme this truth, we must not omit what *Avicenna* in his book *De Anima & Almahad*, and *Monsieur des Cartes* in his Method, doe presse upon the same occasion. Thus they say, or to like purpose: If I cast with my selfe, who I am that walk, or speak, or think, or order any thing; my reason will answer me, that although my legs or tongue were gone, and that I could no longer walk or speak, yet were not *I* gone, and I should know & see with my understanding, that I were still the very same thing, the same *Ego* as before. The same as of my tongue or legs, would reason tell me of my eyes, my eares, my smelling, tasting, and feeling, eyther all of them together, or every one of them single, that were they all gone, still should *I* remaine: As when in a dreame, (where I use none of all these) I both am, and know my selfe to be. Reason will tell me also, that although I were not nourished, so I were not wasted, (which for the drift of the argument may be supposed) yet still I should continue in *being*. Whence it would appeare, that my heart, liver, lungs, kidneys, stomach, mouth, and what other parts of me soever, that serve for the nourishment of my body, might be severed from me, and yet I remain what I am. Nay, if all the beautifull and ayrie fantasmes, which fly about so nimbly in our brain, be nothing else but signes unto in our soule, of what it is without us; it is evident, that though peradventure she would not without their service, exercise that which by errour we mis-name *Thinking*; yet the very same soule and thinker might be without them all: and consequently, without braine also; seeing that our braine is but the play-house and scene, where all these faery masks are acted: so that in conclusion Reason assureth us, that when all body is abstracted in us, there still remaineth a sustance, a thinker, an *Ego*, or *I*, that in it selfe is no whit diminished, by being (as I may say) stripped out of the case it was incloſed in.

And

And now I hope the intelligent Reader will conceive I have performed my promise, and have shewed the Soule of man to be an *Immortall substance*: for since it is a *substance*, it hath a *Being*; and since it is immateriall substance, it hath a *Being* of its owne force; without needing a consort body, to helpe it to sustaine its *Existence*: for to be a substance, is to be the subject of *Existence*; and consequently, to be an immateriall substance, is to be a subject capable of *Existence*, without the helpe of matter or of Quantity. It can not therefore be required of me, to use any further industry, to prove such a soule to be immortall: but who will contradict her being so, is obliged to shew that she is mortall: for it followeth in reason, that she will keepe her *being*, unles by some force she be bereaved of it; it being a rule, that whosoever putteth a thing to be, is not bound, for the continuation of that things being, to prove that it is not changed: but on the other side, he that averreth it is changed, is bound to bring in his evidence of a sufficient cause to change it: for to have a thing remaine, is natures owne dictamen, and followeth out of the causes which gave it *being*: but to make an alteration, supposeth a change in the causes; and therefore the obligation of proofe lyeth on that side.

4. Two other arguments to prove the same: one positive, the other negative.

Nevertheless, to give satisfaction to those, who are earnest to see every article positively proved, we will make that part too our *Province*. Let us then remember, that *Immortality* signifyeth a negation, or a not having of *Mortality*: and that a positive terme, is required to expresse a change by; since nature teacheth us, that whatsoever is, will remaine with the *Being* it hath, unlesse it be forced out of it: if then we shew, that Mans soule hath not those groundes in her, which maketh all things we see, to be mortall; we must be allowed to have acquitted our selves of the charge of proving her *Immortall*. For this end let us looke round about us, and inquire of all the things we meete with, by what meanes they are changed, and come to a period, and are no more. The pure elements will tell you, that they have their Change, by rarefaction and condensation, and no otherwise: mixed bodies, by alteration of their mixture: small bodies, by the activity of the Elements working upon them; and by the meanes of rare-

5. The same is proved becaus the soule can not be obnoxious to the cause of mortality.

faction and condensation entering into their very constitution, and breeding another temperament, by seperation of some of their parts, and in their stead mingling others. Plantes, and trees and other living creatures will tell you, that their nourishment, being insinuated through their whole bodies, by subtile pores, and blinde passages, if they either be stoped by any accident, or else be filled with bad nourishment, the mixture of the whole saileth of it selfe, and they come to dye. Those things which are violently destroyed, we see are made away, for the most part by division; so fire by division destroyeth all that commeth in its way; so living creatures are destroyed by their parting of their bloud from their flesh, or of one member from an other, or by the evaporation or extinction of their naturall heat. In fine, we are sure that all things, which within our knowledge loose their *Being*, do so by reason of their Quantity; which by division, or by rarefaction, and compression, gaineth some new temperature, that doth not consist with their former temper. After these premisses, I need say no more: the conclusion displayeth it selfe readily and plainly, without any further trouble; for if our laboure hath beene hitherto, to shew that our soule is indivisible, and that her opperations are such as admit not quantitative parts in her; it is cleare, that she can not be mortall, by any of those wayes whereby we see things round about us to perish.

The like argument we may frame out of locall motion; for seeing that all the alterative actions we are acquainted withall, be performed by locall motion (as is delivered, both in grosse, and by detaile, in our first Treatise) and that Aristole, and all understanding Phylosophers doe agree, there can be no locall motion in an indivisible thing (the reason whereof is evident, to whomsoever reflecteth upon the nature of *Place*, and of *locall motion*) it is manifest, that there can be no motion to hurt the soule, since shee is concluded to be *indivisible*.

The common argument likewise used in this matter, ammounteth to the same effect: to wit, that since things are destroyed only by their contraries; that thing which hath no contrary, is not subject to destruction: (which Principle both Reason and experience, do every where confirme:) but a humane soule is not subject to contrariety: and therefore such an one can not be destroyed.

*6.* The same is proved because the soule hath no contrary.

ſtroyed. The truth of the aſſumption, may be known two wayes: firſt, becauſe all the contrarieties that are found within our cogniſance, do riſe out of the primary oppoſition of *Rarity*, and *Denſity*; from which the ſoule being abſolutly free, ſhe likewiſe is ſo, from all that groweth out of that rout: and ſecondly, we may be ſure that our ſoule can receive no harme from contrariety; ſince all contraries are ſo far from hurting her, as contrary wiſe, the one helpeth her in the contemplation of the other: & as for contradiction in thoughts, which at different times our ſoule is capable of admitting, experience teacheth us, that ſuch thoughts do change in her, without any prejudice to her ſubſtance, they being accidents, and having their contrariety only betwixt themſelves within her, but no oppoſition at all to her; which only is the contrariety that may have power to harme her: and therefore, whatſoever of ſuch contrary thoughts be in the ſoule, pertaineth no more to her ſubſiſtence, then it doth to the ſubſiſtence of a body, whether it be here or there, on the right hand, or on the left.

7. The ſame is proved from the end for which the ſoule was created.

And thus I conceive my taske is performed; and that I am diſcharged of my undertaking to ſhew the ſoules *Immortality*, which importeth no more, then to ſhew, that the cauſes of other things mortality, do not reach her. Yet being well perſwaded, that my reader will not be offended with the addition of any new light, in this darke ſubject; I will ſtrive to diſcover (if it be poſſible) ſome poſitive proofe, or gueſſe, out of the property and nature of the ſoule it ſelfe, why ſhe muſt remaine, and enjoy another life after this. To this end let us caſt our eye backe, upon what hath beene already ſaid, concerning her nature. We found that *truth* is the naturall perfection of Mans ſoule; and that ſhe can not be aſſured of truth naturally, otherwiſe then by evidence: & therefore it is manifeſt, that evidence of truth, is the full compleat perfection, at which the Soule doth ayme. We found alſo, that the ſoule is capable of an abſolute infinity of truth or evidence. To theſe two, we will ad only one thing more, which of it ſelfe is paſt queſtion, and therefore needeth no proofe; and then we will deduce our concluſion, and this is, that in a man his ſoule is a farre nobler, and perfecter part of him, then his body: and therefore, by the rules of nature and of wiſedome, his body was made for his ſoule, and not his ſoule finally for his body.

Theſe groundes being thus layed, let us examine, whether our ſoule doth in this life arrive to the end ſhe was ordained for, or no: and if ſhe do not then it muſt follow of neceſſity, that our body was made but for a paſſage, by which our ſoule ſhould be ferried over into that ſtate, where ſhe is to attaine unto that end for which her nature is framed and fitted: the great skill, and artifice of nature, ſhewing and aſſuring us that ſhe never faileth of compaſſing her end, even in her meaneſt workes: and therefore without doubt would not breake her courſe in her greateſt, whereof *man* is abſolutely the head and chiefe, among all thoſe that we are acquainted with Now, what the end is, unto which our ſoule doth ayme, is evident; ſince the perfection of every thing, is the *end* for which it is made, the perfection then, and end of the ſoule being *evidence*, and ſhe being capable of infinit *evidence*; let us inquire, whether in this life ſhe may compaſſe it or no. To determine this queſtion, let us compare infinite *evidence*, to that *evidence*, which the greateſt and moſt knowing man that ever lived, hath acquired by the worke of nature alone; or to the evidence, which by aime we may imagine is poſſible ever to happen unto any one man to arrive unto: and balancing them well together, let us judge whether all that any man can know here, is not in reſpect of what a mans ſoule is capable of, to be ſtiled as nothing, and deſerveth not the name of *evidence*, nor to be accounted of that nature: and if our ſentence do conclude upon this, let us acknowledge that our ſoule arriveth not to her perfection, nor enjoyeth her end, in this world, and therefore, muſt have infaillibly an other habitation in the next world, unto which nature doth intend her. Experience teacheth us, that we can not fully comprehend any one of natures workes: and thoſe Philoſophers, who in a diſciplinable way ſearch into nature, (and therefore are called Mathematicians) after they have written large volumes of ſome very ſlender ſubject, do ever find, that they have left untouched, anendleſſe abiſſe of knowledge, for whomſoever ſhall pleaſe to build upon their foundations and that they can never arrive neere ſaying all that may be ſaid of that ſubject, though they have ſaid never ſo much of it. We may not then make difficulty to beleeve, that the wiſeſt and learnedeſt men in the world, have reaſon to profeſſe with the father of Philoſophers, that indeed they know nothing. And if ſo, how far are

they

they from that happineſſe & perfection, which conſiſteth in knowing all things? Of which full ſea, we never theleſſe finde even in this low ebbe, that our ſoule is a channell capable, and is framed a fit veſſell and inſtrument to receive it, when the tide ſhall come in upon it, which we are ſure it can not do, untill the bankes of our body which hinder it be broken downe.

This laſt conſideration, without doubt, hath added no ſmall corroboration to our former prooſes; which are ſo numerous and ſo cleare, as paradventure it may appeare ſuperfluous, to ſay any more to this point; ſince one convincing argument eſtabliſheth the verity of a concluſion, as efficatiouſly as a hundred; and therefore Mathematicians uſe but one ſingle prooſe in all their Propoſitions; after which other ſupernumerary ones, would be but tedious nevertheleſs, ſince all theſe ſeveral wayes, by which we may look into the nature of our ſoule (the importanteſt ſubject we can buſy our thoughts upon) can not faile of being pleaſing and delightfull to us, we muſt not omit to reflect a little upon that great property of our ſoule, by which ſhe is able to move and to worke, without her ſelfe being moved or touched. Vnto which adding, that all Life conſiſteth in motion, and that all motion of bodies commeth from ſome other thing without them; we may evidently conclude, that our ſoule, who can move without receiving her motion from a bread, hath in her ſelfe a ſpring of life; for the which ſhe is not beholding (as Bodies are) to ſome extrinſecal cauſe of a nature like unto her; but only to him, who gave her to be what ſhe is. But if ſhe have ſuch a ſpring of Life within her, it weare unreaſonable to imagine, that ſhe died upon the occaſion of the death of another thing, that exerciſeth no action of life, but as it is cauſed by another.

8. The ſame is proved becauſe ſhe can move without being moved.

Neither may we neglect that ordinary conſideration, which taketh notice, that our ſoule maketh uſe of Propoſitions of eternall truth, which we have above produced, among our prooſes for her being of a ſpirituall nature; and ſhall now employ it for the proving her *Immortall*: by conſidering, that the notion of *Being*, which ſettleth theſe Propoſitions ſo, as they feare no mutation or ſhaking by time, is the very roote of the ſoule; and that which giveth her her nature, and which ſheweth it ſelfe in all her operations: ſo that, if from *Being*, arriveth unto theſe Propoſitions to feare no time, the like muſt of neceſſity betide alſo the ſub-

9. The ſame is proved from her manner of operation which is grounded in *being*.

ſtance of the ſoule. And thus we ſee that her nature is out of the reach of time: that ſhee can comprehend time, and ſet it limits, and that ſhee can thinke of things beyond it, and caſt about for them. All which are cleare teſtimonies, that ſhe is free and ſecure from the all-devouring and deſtroying tyranny of that Saturniall Conquerour of the whole world of matter and of bodies, whoſe ſervant is death.

10. Laſtly it is proved from the ſcience of Morality, the principles whereof would be deſtroied if the ſoule were mortall.

After all theſe prooſes drawn from the nature of the ſoule it ſelfe, every one of them of force to convince her immortality I muſt crave leave to adde one conſideration more, though it ſeemeth to belong unto an others harveſt, namely to the ſcience of Moralls: and it is; that the poſition of Mortality in the Soule, taketh away all morality, and changeth men into beaſts; by taking away the ground of all difference in thoſe things, which are to governe our actions. For ſuppoſing that the ſoule dyeth with the body; and ſeeing that man hath a comprehenſion or notion of time without end; it is evident, that the ſpanne of this life, muſt needs appeare contemptible unto him that well conſidereth and weigheth it againſt the other infinite duration: and by conſequence, all the goods, and evills which are parts of this life, muſt needs become as deſpicable and inconſiderable: ſo that better or worſe in this life, hath not any appearance of difference betweene them; at the leaſt, not enough to make him labour with paine to compaſſe the one, and eſchew the other, and for that end, to croſſe his preſent inclination in any thing, and engage himſelfe in any the leaſt difficult taske: and ſo it would enſue, that if to an underſtanding man, ſome courſe or action were propoſed unto him, as better then that he were going about, or for the inſtant had a minde unto, he would reliſh it, as a great marchant, or a Banquier would doe, who dealing for Milions, one ſhould preſſe him with earneſtneſſe, to make him change his reſolved courſe, for the gaine of a farthing more this way then the other; which being inconſiderable he would not trouble his head with it, nor ſtop at what he was in hand with. In like manner, whoſoever is perſwaded that for an infinite of time he ſhall bee *nothing*, and without ſenſe of all things, hee ſcorneth for this little twinckling of his life, to take any preſent paines, to be in the next moment well or to avoyd being ill; ſince in this caſe dying is a ſecure remedy to any preſent evill; and hee is as ready to dye now, as a hundred yeares hence; nor can he eſteeme the loſſe of a hundred yeares, to bee a matter of moment:

and

and therefore he will, without any further guidance or discourse betake himselfe to doe whatsoever his present inclination beareth him to with most facility; upon this resolution, that if any thing crosse him, he will presently forgoe his life, as a trifle not worth the keeping: and thus, neither vertue, nor honour, nor more pleasure then what at the present tickleth him, doth fall into his account: which is the overthrow of the whole body of *Morality*, that is of mans action and nature. But all they who looke into sciences, doe crosse that for an erroneous and absurd position, which taketh away the Principles of any science: and consequently, the position of the soules *Mortality*, is to bee esteemed such. There remaineth yet one consideration more and peradventure more important, then any we have yet mentioned, to convince the soules immortality: which is, that spirituall things are in a state of *being*. But we shall not be able to delare this untill we have proceeded a little further.

## CHAP. X.

### *Declaring what the soule of a man, seperated from his body, is: and of her knowledge and manner of working.*

1. That the soule is one simple knowing act which is a pure substance and nothing but substance.

VN happy man! how long wilt thou be inquisitive and curious to thine owne perill? Hast thou not already payed too deare, for thy knowing more than thy share? Or hast thou not heard, that who will prye into Majesty, shall be oppressed by the glory of it? Some are so curious (shall I say) or so ignoarnt, as to demand, what a humane soule will bee, after shee is delivered from her body; and unlesse they may see a picture of her, and have whereby to fansie her, they will not be perswaded, but that all are dreames, which our former discourses have concluded: as if hee, who findeth himselfe dazeled with looking upon the Sun, had reason to complaine of that glorious body, and not of his own weake eyes, that can not entertaine so resplendent a light.

Wherefore to frame some conceit of a seperated soule, I wil endeavour for their satisfaction to say somewhat of her future state: Let us then first consider what a thought is, (I do not meane, that corporall spirit, which beateth at our common sense; but that

which is within, in the inward soule, whose nature wee finde by discourse and effects, though wee cannot see it in it selfe.) To this purpose we may observe, that if we are to discourse, or to doe any thing, wee are guided the right way in that subject wee have in hand, by a multitude of particular thoughts; which are all of them terminated in that discourse or action: and consequently every act of our minde, is as it were an actuall rule or direction, for some part of such discourse or action: so that wee may conceive a compleate thought (compounded of many particular ones) to be a thing, that ordereth on entire discourse or action of our life.

A thought being thus described, let us in the next place trye, if we can make an apprehension, what a *Science* or an *Art* is: as, what the *Science* of *Astronomy* is; or what the art of playing on the *Organs* is, when the Astronomer thinketh not of the motions of the Heavens, nor the Organist of playing on his instrument: which science and art, doe nevertheless even then reside in the Astronomer, and in the Organist: and we finde, that these are but the resultes of many former compleat thoughts; as being those very thoughts in remainder; whatsoever this may signifie.

Lastly, Let us conceive (if we can) a *power* or *capacity* to *being*: Vnto which capacity, if any *Being* be brought that it is inseperably glewed and riveted unto it, by its very being a *being*: and if any two things bee brought unto it by the vertue of one *being*, common to both those things, that both of them, by this one *being* doe become one betwixt themselves, and with this *capacity*; and that so there is no end or period of this addition of things, by the mediation of *being*; but that by linkes and rings, all the things that are in the world, may hang together betwixt themselves, and to this power; if all of them may bee brought unto it by the Glew and vertue of *being*: in such sort as we have formerly declared, passeth in the Soule.

Now let us put this together, and make up such a thing, as groweth out of the capacity to *Being*, thus actuated and cleaving to all things that any way have *being*; and wee shall see, that it becommeth a whole entire world, ordered and clinging together with a great strength and necessity, as can proceed from the nature of *being*, and of *contradiction*: and our reason will tell us, that

that such a thing, if it be active, can frame a world, such an one as we live in, and are a small parcell of, if it have matter to worke upon; and can order whatsoever hath *Being*, any way that it is capable of being ordered, to do by it, and to make of it, whatsoever can be don by, and made of such matter.

All these conceptions (especially by the assistance of the last) may serve a litle to shadow out a perfect soule, which is, *a knowledge, an art, a rule, a direction, of all things*: and all this by being all things, in a degree & straine, proper and peculiar to it selfe: & an unperfect soule, is a participation of this Idea: that is, a knowledge, a rule, and a direction, for as much as it is, and as it attaineth unto. Now as in our thoughts it is the corporeall part only which maketh a noise, and a shew outwardly, but the spirituall thought, is no otherwise perceived then in its effect, in ordering the bodily acts; in like sort, we must not conceive this knowledge to be a *motion*; but meerely to be a *thing* or *Being*, out of which the ordering and moving of other things doth flow; it selfe remaining fixed and immoveable; and because all that is joyned unto it, is there riveted by *Being*, or *identification*; and that when one thing is an other, the other is againe it; it is impossible that one should exceed the other, and be any thing that is not it: and therefore, in the soule there can be no parts, no accidents, no additions, no appendances, nothing that sticketh to it and is not it: but whatsoever, is in her is *soule*, and the soule, is all that which is within her; so that all that is of her, and all that belongeth unto her, is nothing but one pure simple substance peradventure Metaphysically, or formerly divisible; (in such sort as we have explicated in the first Treatise, of the divisibility betweene quantity and substance) but not quantitatively, as bodies are divisible. In fine, substance it is, and nothing but substance; all that is in it, being joyned and imped into it, by the very nature of *Being*, which maketh substance. This then, is the substantiall conceit of a humane soule stripped of her body.

That a sepe-rated soule is in no place, and yet is not absent from any place.

Now, to conceive what proprieties this substance is furnished with; let us reflect upon the notions we frame of things, when we consider them in Common: as when we think of a man, of bread, of some particular vertue, of a vice, or of whatsoever else; and let us note, how in such our discourse determineth no *place*, nor *time*; nay, if it should, it would marre the discourse; as Logitians shew, when

when they teach us, that ſcientificall ſyllogiſmes can not be made without univerſall propoſitions: ſo that we ſee, unles theſe things be ſtripped from *Place* and *Time*, they are not according to our meaning: and yet never the leſſe, we give them both the name and the nature of a *Thing*, or of a *ſubſtance*, or of a *living Thing*, or of whatſoever elſe may by our manner of conceiving or endeavours, be freed from the ſubjection of *time* and *Place*. Thus then we plainely ſee, that it is a very different thing, *to be*, and *to be in a Place*: and therefore, out of a *Thinges being in no Place*, it can not be inferred, *That it is not*; or *that it is no ſubſtance*: nor contrariwiſe, out *of its being*, can it be inferred, *that it is in a Place*: there is no man but of himſelfe perceiveth the falſe conſequence of this argument, a thing is, therefore it is hot, or it is cold: and the reaſon is, becauſe hot and cold, are particular accidents of a body; and therefore a body can be without either of them. The like proportion is betweene *Being* in generall, & *Being a Body*, or *Being in a Body*: for both theſe, are particulars in reſpect of *Being*: but *to be in a place*, is nothing elſe, but *to be in a circumſtant Body*: and ſo what is not in a Body, is not in a Place: therefore, as it were an abſurd illation to ſay, *it is*, therefore it is in a *Body*; no leſſe is it to ſay, *it is*, therefore *it is ſomewhere*; which is equivalent to, *in ſome Body*: and ſo a great Maſter (Peradventure one of the greateſt, and judicioueſt that ever have beene) telleth us plainly, that of it ſelfe it is evident, to thoſe who are truly learned, that *incorporeall ſubſtances are not in Place*: and Ariſtotle teacheth us, *that the Vniverſe is not in Place*.

But now to make uſe of this diſcourſe, we muſt intimate what it is we levell at in it: we direct it to two ends; firſt, to lead on our thoughts, and to helpe our apprehention, in framing ſome conception of a ſpirituall ſubſtance, without reſidence in *Place*, and to prevent our fancies checking at ſuch abſtraction; ſince we ſee that we uſe it in our ordinary ſpeech, when we think not on it, nor labour for it, in all univerſall and indefinite termes: next to trace out an eminent propriety of a ſeperated ſoule: namely, that ſhe is no where; and (yet upon the matter) that ſhe is every where: that ſhe is bound to no place, and yet remote from none: that ſhe is able to worke upon all, without ſhifting from one to another, or comming neere any: and that ſhe is free from all, without removing or parting from any one.

A second propriety, not much unlike the first, we shall discover in a separated soule, if we compare her with *time*. Wee have heretofore explicated, how *time* is the motion of the heavens; which giveth us our motion; which measureth all particular motions; and which compprehendeth all bodies, and maketh them awaite his leisure. From the large Empire of this proud Commander, a separated soule is free: For although shee doe consist with time, (that is to say, shee is, whiles time is;) yet is shee not in time; nor doth shee in any of her actions, expect time; but she is able to frame time, to spinne or weave it out of her selfe, and to master it.

3. That a separated soule is not in time nor subject to it.

All which will appeare manifestly, if wee consider what it is *to be in time*. *Aristotle* sheweth us; that, *to be comprehended under time*, or *to be in time*, is, to be one of those moveables, whose *being* consisting in motion, taketh up but a part of *time*; and hath its termes, before, and behind, in *time*; and is measured by *time*; and must expect the flowing of *Time*, both for *being*, and for *action*. Now all this manifestly belongeth unto bodies, whose both *action* and *being*, is subject to a perpetuall locall motion and alteration: and consequently, a separated soule, who is totally a *being*, and hath her whole operation all together (as being nothing but her selfe when we speake of her perfective operation;) can not be said to bee in time, but is absolutely free from it; though time doe glide by her, as it doth by other things: and so, all that she knoweth or can doe, she doeth and knoweth at once, with one act of the understanding, or rather, *She* is, (indeed and really) *all that*: and therefore shee doth not require time to manage, or order her thoughts, nor doe they succeed one an other, by such vicissitudes as men are forced to thinke of things by, because their fansie, and the Images in it which beate upon the soule to make her thinke, whiles she is in the body, are corporall, and therefore doe require time to move in, and to give way to one and other: but shee thinketh of all the things in the world, and of all that shee can thinke of, together and at once; as hereafter we intend to shew.

A third propriety we may conceive to be in a separated soule, by apprehending her to bee *an Activity*; which that wee may rightly understand, let us compare her in regard of working, with a body: reflecting then upon the nature of bodies, we shall find, that

4. That the soule is an active substance and all in it is activitie.

that not any of them will doe the functions they are framed for, unlesse some other thing doe stirre them up, and cause them so to doe. As for example; a knife, if it be thrust or pressed, will cut, otherwise, it will lye still and have no effect: and as it fareth with a knife, so it doth in the same manner with those bodies, which seeme most to move themselves; as upon a little consideration, will appeare plainly. A beast seemeth to move it selfe: but if we call to mind, what we have delivered upon this subject in the first Treatise, wee shall finde that whensoever he beginneth to move, he either perceiveth something by his sense, which causeth his motion, or else he remembreth something that is in his braine, which worketh the like effect. Now if sense presenteth him an object that causeth his motion, we see manifestly, that it is an externall cause which maketh him move: but if memory doe it, wee shall find that stirred by some other part; as by the stomack, or by the heart, which is empty, or heated, or hath received some other impression from an other body; so that, sooner or latter, we shall discover an outward mover. The like is in naturall motions; as, in heavy things, their easie following (if they bee sucked) an other way then downwards, testifyeth that their motion downwards hath an extrinsecall motor, as is before declared: and not only in these, but throughout, in all other corporall things. So that in a word, all bodies are of this nature, that unlesse some other thing presse them and alter them, when they are quiet, they remaine so; and have no activity, otherwise then from an extrinsecall mover: but of the soule, we have declared the contrary; and that, by its nature, motion may proceed from it, without any mutation in it, or without its receiving any order, direction, or impulse, from an extrinsecall cause.

5. A Description of the Soule.

So that, now summing up together, all we have said upon this occasion, we finde a soule exempted from the body, to be; *An indivisible substance, exempted from place and time, yet present to both: an actuall and present knowledge of all things that may bee knowne: and a skill or rule, even by what it selfe is, to all things whatsoever.* This she is, if she be perfect: but if she be imperfect; then, is she all this to the proportion of her growth, (if so I may say) and shee is powerfull according to the measure of her knowledge, and of her will. So that in fine, a separated soule, is of a nature to have, and to know, and to governe all things.

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I may reasonably suspect, that my saying how imperfect soules are rules *to the proportion of their growth*, may have occasioned great reflection, and may have bred some trouble in the curious and heedefull Reader. I confesse this expression was delivered by me, only to free my selfe for the present from the labour of shewing what knowledge every seperated soule hath: but upon second thoughts, I find that such sliding over this difficult point will not serve my turne, nor save me the paines of untying this knot: for unlesse I explicate what I meane by that speech, I shall leave my Reader in great doubt and anxiety; which to free him from, I must wade a little further in this question *of the extent of a seperated soules knowledge*, into which, I have thus, upon the by, engaged my selfe: but let him first be advertised, that I doe not here meddle, with what a seperated soule may know by revelation, or by supernaturall meanes: but that I doe only tracke out her naturall paths; and doe guesse at what she is, or knoweth, by that light which her conversation in her body affordeth us.

6. That a separated soule knoweth all that which she knew whilst she was in her body.

Our entrance into this matter must be, to consider what mutation in respect of knowledge, a soules first change out of her body, maketh in her; for it is not unlikely, but that nature may some way enlighten us so farre, as to let us understand what must follow out of the negation of the bodies consortship, added unto what we know of her and other works in this world. This then first occurreth that surely she can not choose but stil know in that state, all that she did know whiles she was in the body; since we are certain that the body hath no part in that which is true knowledge: as is above declared, when we shewed; first, that all true knowledge is respective; secondly, that the first impressions of the fancie, doe not reach to the interiour soule, and lastly, that she worketh by much more, then what hath any actuall correspondence in the fancie, and that all things are united to her by the force of *Being*: from which last, it followeth that all things she knoweth, *are her selfe*; and she, *is, all that she knoweth*: wherefore, if shee keepeth *her selfe* and her owne *being*, shee must needs keepe the knowledge of all that she knew in this world.

Next

7. That the least knowledge which the soul acquireth in her body of any one thing doth cause in her, when shee is seperated from her body a compleat knowledge of al things whatsoever.

Next, she must undoubtedly know then somewhat more, then she knew in the body; for seeing that out of the things shee already knoweth, others will follow by the meer ordering and connexion of them; and that the soules proper worke, *is to order things*: we can not doubt, but that, both the things she knoweth in this world, must of necessity bee ordered in her to the best advantage; and likewise, that all that will be knowne, which wanteth no other cause for the knowing of it, but the ordering of these things: For if the nature of a thing, were *Order*, who can doubt but what were put into that thing, were put into *Order*? Now, that the nature of the soule is such, we collect easily; for seeing that all order proceedeth from her, it must bee acknowledged that *Order* is first in her: but what is in her, is her nature, her nature then is *Order*, and what is in her is ordered. In saying of which, I doe not meane that there is such an order betweene the notions of a separated soule, as is betweene materiall things that are ordered by the soule whiles she is in the body; for seeing that the soule adæquate cause of such order; (that is to say, a cause which can make any an such, and the whole kinde of it;) it followeth, that such order is not in her; for if it were, she would be cause of her selfe, or of her owne parts. Order therefore, in her, must signifie a thing more eminent, then such inferiour order, in which resideth the power of making that inferiour *Order*: and this is nothing else, but the connexion of her notions by the necessity of *being*; which we have often explicated. And out of this eminent or superiour kinde of order our conclusion followeth no lesse then if the inferiour order which wee see in our fansies, whiles our soule is in our body, did reside in our interiour soule; for, it is the necessity of identification, which doth the effect, and maketh the soule know; and the order of fantasmes, is but a precedent condition in the bodily Agent, that it may work upon the soule; and if more fantasmes then one could be together, this *order* would not be necessary.

Out of this, a notable aad a vast conclusion manifestly followeth: to wit, that if a soule, can know any one thing more when she is out the *body*, then what she did know whiles she was in the body; without any manner of doubt, shee knoweth all that can

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bee drawne, and forced out of those knowledges, vvhich shee had in her body. How much this is, and hovv farre it will reach, I am afraid to speake: only I entreate Mathematicians, and such as are acquainted with the manner hovv sciences proceed; to consider how some of their definitions are made: to vvit by composing together sundry knowne termes, and giving a nevv name to the compound that resulteth out of them: wherefore cleare it is, that out of fewer notions had at the first, the soul can make many more and the more shee hath, or maketh, the more shee can multiply. Againe, the maximies, which are necessary to be added unto the definitions for gaining of knowledge, wee see are also compounded of ordinary and knowne termes; so that a separated soule, can want neither the Definitions, nor the Maximies, out of which the bookes of sciences are composed: and therefore, neither can the sciences themselves be wanting unto her. Now if wee consider, that in the same fashion as demonstrations are made, and knowledge is acquired in one science, by the same meanes, there is a transcendence from science to science: and that there is a connexion among all the sciences, which fall into the consideration of man, and indeed among all, at the least corporall things; (for of spirituall things, wee can not so assuredly affirme it; although their perfection may perswade us, that there is rather a greater connexion among them, then among corporall things) it will follow, that a soule vvhich hath but any indifferent knowledge in this vvorld, shall be repleniſhed with all knovvledge in the nexr.

But how much is this indifferent knovvledge, that for this purpose is required in this vvorld? Vpon mature consideration of this point, it is true, I finde it absolutely necessary, that the soule must have here so much knovvledge, as to bee able to determine that some one thing, vvhich hath connexion vvith all the rest, is in such a time: but then, vvhy out of this very conception, she should not bee able to clymbe up by degrees, to the knowledge of all other things vvhatsoever (since there is a connexion between that, and all the rest, and no untransible gappe, or Chaos to sever them) I professe I doe not see. Which if it bee so, then the soule of an abortive in his mothers Wombe, if hee once arrive to have sense, and from it, to receive any impression in his soule, may for ought

ought I know, or can ſuſpect to the contrary, be endewed in the next world with as much knowledge, as the ſoule of the greateſt Clerke that ever lived: and if an abortive do not arrive ſo farre, as to the knowledge of ſome one thing, I know no reaſon, why we ſhould beleeve it arrived to the nature of man.

Whence it followeth, that this amplitude of knowledge, is common to all humane ſoules, (of what pitch ſoever they ſeeme to be here) when they are ſeperated from their bodies: as alſo, that if any error have crept into a mans judgement, during this life, whether it be of ſome univerſall concluſion, or of ſome particular thing, all ſuch will be aboliſhed then, by the truth appearing on the oppoſite ſide; ſithence two contradictory judgements, can not poſſeſſe our ſoule together: as even in this world as well experience, as reaſon teacheth us.

An anſwer to the objections of ſome Peripatetikes who maintaine the ſoule to periſh with the body.

But unawares I have engulfed my ſelfe into a ſea of contradiction, from no meane adverſaries: for Alexander, Aphrodiſeus, Pomponatius and the leranedeſt of the Peripatetike ſchoole, will all of them riſe up in maine oppoſition againſt this doctrine of mine: ſhewing how in the body, all our ſoules knowledge is made, by the working of our fanſie; and that there is no act of our ſoule, without ſpeculation of fantaſmes reſiding in our memory: therefore, ſeeing that when our body is gone, all thoſe little bodyes of fantaſmes are gone with it; what ſigne is there, that any operation can remaine? And hence they inferre, that ſeeing every ſubſtance hath its *Being* for its operations ſake, and by conſequence were vaine and ſuperfluous in the world, if it could not enjoy, and exerciſe its operation; there is no neceſſity or end, why the ſoule of a man ſhould ſurvive his body: and conſequently, there is no reaſon to immagine other, then that it periſheth when the man dieth. This is the ſubſtance of their Argument; which indeed is nothing elſe, but to gueſſe without ground, or rather againſt all ground: but howſoever, this comfort I have, that I have to doe with Peripatetikes; men that will heare and anſwer reaſon: and to ſuch I addreſſe my ſpeech.

To joyne iſſue then with them, and to encounter them with their owne weapons, let us call to minde, what Ariſtotle holdeth light to be. He ſaith, *that it is a ſuddaine and momentary cog-*

*nation*

*nation of what it is, following the precedent motion of some bodie, but without motion in it selfe.* As for example: when the Sunne commeth into our horison, (saith he) the illumination of the Horison, is an effect in an instant, following from the motion which the Sunne had, since his setting in the other Hemisphere, untill hee appeare there againe: so that (according to him) the way of making this light, is the Sunnes locall motion; but the effect or *the being enlightned*, is a thing of a very different nature, done without beginning, and continuing untill the Sunne depart againe from our Horison. And as hee explicateth this action of illumination, in the same manner, doth hee the actions of sense and of understanding. Vpon all which I urge, that no Peripatetike will deny mee, but that as in every particular sensation or thinking, there proceedeth a Corporall motion, out of vvhich it ensueth, so this generall motion, which wee call *the life of man*, precedeth that twinkle or moment, in which shee becommeth an absolute spirit, or inhabitant of the next world. Wherefore it cannot bee said, that wee introduce a doctrine aliene from the Peripatetike way of Philosophising, if wee put a momentary effect or motion (according to their phrase of speaking) to follow out of the course of mans life; since they put diverse such effects, to follow out of particular parts of it.

Now, this momentary change, or what they please to call it, is that which maketh at one blow, all this knowledge we speake of: for, if we remember that knowledge is not a *doing* or a *motion*, but a *Being*; as is agreed betweene the Peripatetikes and us; they cannot, for the continuing it, require instruments and motors: for they are necessary onely for change, not for *being*. Now, all this mighty change, which is made at the soules delivery, vve conceive follovveth precisely out of the change of her *Being*: for seeing it is supposed, that her *Being* vvas before in a body, but is now out of a body; it must of necessity follovv, that all impediments, which grevv out of her being in a body, must bee taken away by her being freed from it. Among which impediments, one is, that time is then required betwixt her

knowledge of one thing, and her knowledge of an other thing; and so her capacity, that of it selfe is infinite, becometh confined to that small multitude of objects, which the division and straightnesse of time giveth way unto. Now that, which length of time could in part worke in the body, the same is entirely done in a moment, by the changing of her manner of *being*: for by taking away the bondes, by which she was enthralled in the body, & was kept in, to apprehend but according to the measure of the body, and was conconstrained to be, and to enjoy her selfe (as it were) but at the bodies permission; she is put in free possession of her selfe, and of all that is in her. And this is nothing else, but to have that large knowledge, wee have spoken of, for her knowing all that, is no other thing but her being her selfe perfectly. Which will appeare evident, if we consider that her nature is, *to bee a Knower*, and that Knowledge is nothing else but a *Being of the object in the Knower*; for thence it followeth, that to know all things is naught else then to bee all things: since then, wee concluded by our former discourse, that all things were to bee gathered out of any one; it is cleare that to be perfectly her selfe, and any one thing, is in truth to know all things.

And thus wee see, that for the soules enjoying all this knowledge when shee is out of the body, shee needeth no objects without her, no phantasmes, no instruments, no helpes; but that all that is requisite, is contained absolutely in her being her selfe perfectly. And so wee retort our Adversaries Objection on themselves; by representing to them, that since in their owne doctrine, they require no body nor instruments, for that precise action which they call understanding: it is without all ground, for them to require bodies and instruments in the next life, that the soule may there be that, which; they acknowledge shee is in her body without any such helpes.

And as for that *Axiome* or experience, *that the Soule doth not understand, unlesse shee speculate phantasmes:* as on the one side I yeeld to it, and confesse the experience, after the best and seriousest tryall I could make of it; so on the other

side,

side, when I examine the matter to the bottome, I find that it commeth not home to our adversaries intention. For as when we looke upon a thing, we conceive we worke upon that thing, whereas in truth we do but set our selves in such a position that the thing seene may worke upon us: in like manner our looking upon the phantasmes in our braine; is not our soules action upon them, but it is our letting them beat at our common sense; that is, our letting them worke upon our soule. The effect whereof is, that either our soule is bettered in her selfe, as when we study and contemplate: or else, that she betters something without us, as when by this thinking, we order any action.

But, if they will have this *Axiome* avayle them, they shold shew that the soule is not of her selfe a knowledge; which if they be able to do, even then when to our thinking, she seemeth not so much as to thinke, we will yeeld they have reason: but that will be impossible to them to do; for she is alwayes, of her selfe, a knowledge, though in the body she never expresseth so much, but when she is put to it. Or else they should shew, that this knowledge which the soule is of her selfe, will not by changing the manner of her *Existence*, become an actuall knowledge, instead of the habituall knowledge which now appeareth in her.

9. The former Peripatetickes refuted out of Aristole.

But as these Aristotelians embrace and sticke to one *Axiome* of their Patrone; so they foregoe and prevaricate against an other: for as it is Aristotles doctrine, that a substance is for its operation, and were in vaine and superfluous if it could not practise it; so likewise it is confessed doctrine, that *Matter* is for its *forme*, and not the *forme* for the *matter*. And yet these men pretend that the soule, serveth for nothing but the governing of the body: whereas contrariwise, both all Aristoties doctrine, and common sense convinceth, that the body must be for the soule. Which if it be, nothing can be more consentaneous to Reason, then to conceive that the durance which the soule hath in the body, is assigned her, to worke and mould in her the future state, which she is to have after this life: and that no more operations are to be expected from her

after this life, but instead of them, a setled state of *Being*, seeing that, even in this life, according to Arist. doctrine, the proper operations of the soule are but certaine *Beings*: so that we may conclude, that if a soule were growne to the perfection, which her nature is capable of, she would be nothing else but a constant *Being* never changing from the happinesse of the best *Being*.

And although the texts of Aristotle which remaine unto us, be uncertaine (peradventure, not so much because they were originally such in themselves, as through the mingling of some comments into the body of the text;) yet if we had his booke which he wrote of the soule upon the death of his freind Eudemus, it is very likely we should there see his evident assertion of her *Immortality*; since it had beene very impertinent to take occasion upon a friends death to write of the soule, if he intended to conclude, that of a dead man there were no soule.

10. The operations of a separated Soule compared to her operations in her bodie.

Out of this discourse it appeareth how those Actions which we exercise in this life, are to be understood, when we heare them attributed to the next: for to thinke that they are to be taken in their direct plaine meaning, and in that way, in which they are performed in this world; were a great simplicity, and were to immagine a likenesse betweene bodies and spirits, we must therefore elevate our mindes, when we would penetrate into the true meaning of such expressions, and consider how all the actions of our soule are eminently comprehended in the universality of knowledge, we have already explicated. And so, the Apprehensions, judgements, discourses, reflections, talkings together, and all other such actions of ours, when they are attributed to separated soules, are but inadæquate names and representations of their instantaneall sight of all things, for, in that, they can not choose but see others mindes, which is that we call talking, and likewise their owne, which we call reflection: the rest are plaine partes, and are plainely contained in knowledge; discourse being but the falling into it; judgement the principles of it; and single apprehensions the components of judgements.

then

then for such actions as are the beginning of operation, there can bee no doubt but that they are likewise to be found, and are resumed, in the same Vniversality; as, love of good, consultation, resolution, prudentiall election, and the first motion; for who knoweth all things, can not choose but know what is good, and that good, is to bee prosecuted: and who seeth compleatly al the meanes of effecting & attaining to his intended good; hath already consulted & resolved of the best: & who understandeth perfectly the matter he is to work upon, hath already made his prudential election: so that there remaineth nothing more to be don but to give the first impulse.

And thus you see, that this universality of knowledge in the soule, comprehendeth all, is all, performeth all; and no imaginable good or happinesse, is out of her reach. A noble creature, and not to be cast away upon such trash as most men employ their thoughts in. Vpon whom it is now time to reflect; and to consider, what effects the divers manners of living in this world, do work upon her in the next; if first wee acquit our selves of a promise wee made at the end of the last Chapter. For it being now amply declared, that the state of a Soule exempted from her body, is a state of pure *being*; it followeth manifestly, that there is neither action nor passion in that state: which being so, it is beyond all opposition that the soule can not dye: for it is evident that all corruption, must come from the action of an other thing, upon that which is corrupted; and therefore that thing must be capable of *being* made better and of being made worse. Now then, if a separated soule be in a finall state, where she can neither bee bettered, or worsened, (as she must be, if she be such a thing as we have declared) it followeth that shee can not possibly loose the *Being* which she hath: and sithence her passage out of the body, doth not change her nature, but only her state; it is cleare, that she is of the same nature even in the body: though in this her durance, she be subject to be forged (as it were) by the hammers of corporeall objects beating upon her; yet so, that of her selfe she still is what she is. And therefore as soone as she is out of the passible oore, in which shee suffereth by reason of that oore, shee presently becommeth impassible, as *being* purely of

her owne nature, a fixed ſubſtance, that is, a pure *being*. Both which ſtates of the ſoule, may in ſome ſort be adumbrated by what we ſee paſſeth in the coppelling of a fixed mettall; for as long as any lead, or droſſe, or allay remaineth with it, it continueth melted, flowing, and in motion under the muffle: but as ſoone as they are parted from it, and that it is become pure, without any mixture, and ſingly it ſelfe; it contracteth it ſelfe to a narrower roome, and at that very inſtant, ceaſeth from all motion, groweth hard, permanent, reſiſtent unto all operations of fire, and ſuffereth no change or diminution in its ſubſtance by any outward violence we can uſe unto it.

## CHAP. XI.

*Shewing what effects, the divers manners of living in this world, doe cauſe in a ſoule, after ſhe is ſeparated from her body.*

1. That a ſoule in this life is ſubject to mutation, and may be perfected in knowledge.

ONe thing may peradventure ſeeme of hard digeſtion in our paſt diſcourſe; and it is, that out of the grounds we have laid, it ſeemeth to follow that all ſoules will have an equality; ſince we have concluded, that the greateſt ſhall ſee or know no more than the leaſt: and indeed, there apeareth no cauſe why this great and noble creature, ſhold ly impriſoned in the obſcure dungeon of noyſome fleſh; if in the firſt inſtant, in which it hath its firſt knowledge it hath then already gained all whatſoever it is capable of gaining in the whole progreſſe of a long life afterwards. Truly, the Platonike Philoſophers (who are perſwaded that a human ſoule doth not profit in this life, nor that ſhe acquired any knowledg here; as being of her ſelfe compleately perfect, and that all our diſcourſes, are but her remembrings of what ſhe had forgotten) will find themſelves ill beſted to render a Philoſophicall and ſufficient cauſe of her being locked into a body: for to put forgetfulnes in a pure ſpirit; ſo palpable an effect of corporeity, and ſo great a corruption, in reſpect of a creature whoſe nature is, to know of it ſelfe, is an unſuffetable errour. Beſides, when they tell us, that ſhee can not bee changed, becauſe all change would prejudice the ſpirituall nature, which they attribute to her; but that well ſhe may be warned and exciated by being in a body;

body; they meerly trifle: for either there is some true mutation made in her by that which they call a warning, or there is not; if there be not, how becommeth it a warding to her? Or what is it more to her then if a straw were wagged at the *Antipodes*? But if there be some mutation (be it never so little) made in her by a corporeall motion; what should hinder, why she may not by means of her body, attaine unto science she never had; as wel as by it receive any the least intrinsecall mutation whatsoever? For if once we admit any mutability in her from any corporeall motion it is far more conformable unto reason to suppose it in regard of that which is her naturall perfection, & of that, which by her operations wee see she hath immediately after such corporeall motions, and wherof before them there appeared in her no marks at all; then to suppose it in regard of a dark intimation, of wch we neither know, it is not how it is performed. Surely, no Rationall Philosopher seeing a thing, whose nature is to *know*, have a *being*, whereas formerly it existed not; & observing, how that thing by little and little giveth signes of more and more knowledge, can doubt but that as she could be changed from not *being* to *being*; so, may shee likewise bee changed from lesse knowing, to more knowing.

This then being irrefragably setled, that in the body she doth encrease in knowledge: let us come to our difficulty & examine what this encrease in the body availeth her; seeing that as soone as she parteth from it, she shall of her own nature enjoy, and be replenished with the knowledge of all things: why should she laboriously strive to anticipate the getting of a few drops which but encrease her thirst and anxiety; when having but a little patience, she shall at one full and everlasting draught drink up the whole sea of it? We know that the soule is a thing, made proportionably to the making of its body; seeing it is the bodies compartner: and wee have concluded, that whiles it is in the body, it acquireth perfection in that way, which the nature of it is capable of: that is, in knowledge: as the body acquireth perfection its way; which is, in strength and agility. Now then let us compare the proceedings of the one, with those of the other substance; and peradventure wee may gaine some light to discerne what advantage it may prove unto a soul, to remain long

2. That the knowledges which a soul getteth in this life will make her knowledge in the next life more perfect and firme.

in its body; if it make right vse of its dwelling there. Let vs consider the body of a man, well and exactly shaped in all his members; yet if he never vse care, nor pains to exercise those well framed limbes of his; he will want much of those corporeall perfections, which others will have, who employ them sedulously. Though his legges, armes, and handes, be of an exact symmetry; yet he will not be able to runne, to wrestle, or to throw a dart, with those who labour to perfect themselves in such exercises: though his fingers be never so neatly moulded or composed to all advantages of quick and smart motion; yet if he never learned and practised on the lute, he will not be able with them to make any musike upon that instrument, even after he seeth plainly, and comprehendeth fully all that the cunningest Luteniſt doth; neither will he be able to play, as he doth with his fingers, which of themselves are paradventure les apt or those voluble motions then his are. That which maketh a man dexterous in any of these arts, or in any other operations, proper to any of the partes or limbes of his body, is the often repetitions of the same Acts; which do amend, and perfect those limbes in their motions, and which make them fit & ready for the actions they are designed unto.

In the same manner it fareth with the soule; whose essence is that which she knoweth: her severall knowledges may be compared, to armes, hands, fingers, legges, thighes &c. in a body: and all her knowledges taken together, do compose (as I may say) and make her up, what she is. Now, those limbes of hers, though they be, when they are at the worst, entire, and well shaped in bulke (to vse the comparison of bodies. Yet they are susceptible of further perfection, as our corporeall limbes are, by often and orderly vsage of them. When we iterate our acts of our understanding any object, the second act is of the same nature, as the first, the third as the second, and so, of the rest: every one of which perfecteth the understanding of that thing, and of all that dependeth upon the knowledge of it, and maketh it become more vigorous and strong; even the often throwing of a boule at the same marke, begetteth still more and more strength and justnesse in the Arme that delivereth it: for, it can not be denyed

but

but that the same cause which maketh any thing, must of necessity perfect and strengthen it, by repeating its force and stroakes. We may then conclude that the knowledge of our soule, (which is indeed her selfe) will be in the next life more perfect and strong, or, more slake and weake, according as in this life she hath often and vigorously, or faintly and seldome, busied her selfe about those things which beget such knowledge.

3. That the soules of men addicted to science whilst they lived here are more perfect in the next world then the soules of unlearned men.

Now those things which men bestow their paines to know, we see are of two kindes: for some thirst after the knowledge of nature, and of the variety of things, which either their senses, or their discourse, tell them of: but others looke no higher then to have an insight into humane action, or to gain skill in some art, whereby they may acquire meanes to live. These latter curiosities, are but of particulars; that is, of some one, or few species, or kindes, whose common that comprehendeth them, falleth within the reach of every vulgar capacity; and consequently, the things which depend upon them, are low, meane, and contemptible: whereas the beauty, vastnesse, and excellency of the others, is so much beyond them, as they can be brought into no proportion to one another. Now then, if we consider, what advantage the one sort of these men, will in the next world have over the other; we shall find, that they who spend their life here in the study and contemplation of the first noble objects, will, in the next, have their universall knowledge (that is their soule) strong and perfect: whiles the others, that played away their thoughts and time upon trifles, and seldome raised their mindes above the pitch of sense, will be faint through their former lazinesse, like bodies benummed with the palsey, and sickely through their ill dyet, as when a well shaped virgin, that having fed upon trash instead of nourishing meates languisheth under a wearisome burthen of the greene sickneſse.

4. That those soules which embrace vertue in this world will be most perfect in the next, and those which embrace vice most miserable.

To make this point yet more cleare, we may consider how the things which we gaine knowledge of, do affect us under the title of good and convenient, in two severall manners. The one is, when the appearance of good, in the abstracted nature of it, & after examination of al circumstances, carryeth our

our heart to the desire of the thing, that appeareth so unto us: the other is, when the semblance of good to our owne particular persons without casting any further, or questioning whether any other regard may not make it prejuditiall, doth cause in us a longing for the thing wherein such semblance shineth. Now for the most part the knowledges which spring out of the latter objects, are more cultivated by us, then those which arise out of the other; partly by reason of their frequent occurring, either through necessity, or through judgement; and partly, by the addition which passion giveth to the impressions they make upon us: for passion multiplyeth the thoughts of such things, more then of any others, if reason do not crosse and suppresse her tumultuary motions, which in most men, she doth not. The soules then of such persons, as giving way to their passion, do in this life busie themselves about such things as appeare good to their owne persons, and cast no further, must needes decede from their bodys, unequally builded, (if that expression may be permitted me;) and will bee like a lame unwieldy body, in which the principall limbes, are not able to governe and move the others; because those principall ones are fainte, through want of spirits and exercise; and the others are overgrowne with hidropicall and nocive humours. The reason whereof is that in such soules their judgements will be disproportioned to one another, one of them being unduely stronger then the other. What effect this worketh, in regard of knowledge, we have already declared, and no lesse will it have in respect of action: for suppose two judgements to be unequall, and such, as in the action one contradicteth the other, for example, let one of my judgements be, that it is good for me to eate because I am hungry; and let the other be, that it is good for me to study, because I am shortly to give an account of my selfe, if the one judgment be stronger then the other, as if that of eating be stronger then that of studying, it importeth not that there be more reason (all circumstances considered) for studying: because, reasons, do move to action according to the measure in which the resolution that is taken upon them, is strong or weake; and therefore, my action will follow the

strongest

ſtrongeſt judgment, and I ſhall leave my booke to go to my dinner.

Now, to apply this to the ſtate of a ſeperated ſoule; we are to remember how the ſpirituall judgements, which ſhe collected in the body, do remaine in her after ſhe is diveſted of it: and likewiſe, we are to conſider, how all her proceeding in that ſtate, is built, not upon paſſion, or any bodily cauſes or diſpoſitions; but meerely upon the quality and force of thoſe ſpirituall judgments: and then, it evidently followeth, that if there were any ſuch action in the next life, the pure ſoule would apply it ſelfe thereunto, according to the proportion of her judgements, and as they are graduated and qualified. It is true, there is no ſuch action remaining in the next life; yet nevertheleſſe there ramaineth in the ſoule a diſpoſition and a promptitude to ſuch action; and if we will frame a right apprehenſion of a ſeperated ſoule, we muſt conceit her to be of ſuch a nature (for then all is nature with her, as hereafter we ſhall diſcourſe.) as if ſhe were a thing made for action in that proportion and efficacity, which the quartering of her by this variety of judgements doth afford; that is that ſhe is, ſo much the more fit for one action then for another, (were ſhe to proceed to action,) as the judgment of the goodneſſe of one of theſe actions is ſtronger in her, then the judgment of the others goodneſſe, which is in effect, by how much the one is more cultivated then the other. And out of this we may conclude, that what motions do follow in a man, out of diſcourſe, the like will in a ſeperated ſoule, follow out of her ſpirituall judgments. So that as he is joyed, if he do poſſeſſe his deſired good; and is diſcontented and diſpleaſed, if he miſſe of it and ſeizeth greedily upon it when it is preſent to him, and then cleaveth faſt unto it, and whiles he wanteth it, no other good affecteth him, but he is ſtill longing after that Maſter-wiſh of his heart: the like in every regard, but much more vehemently, befalleth unto a ſeperated ſoule. So that in fine ſhe will be happy, or miſerable, according as ſhe hath built up her ſelfe, by her ſpirituall judgments and affections in this life. If knowledge and intellectual objects be the goods ſhe thirſteth after, what can be happier then ſhe, when ſhe poſſeſſeth the

fullneſſe

fullneſſe of all that can be deſired in that kinde? But if in this world a man ſettleth his heart conſtantly upon any tranſitory end; as upon wealth corporeall delights, honour, power, and the like, (which are too ſhort breathed attendants to follow him ſo long a journey as into the next;) then, all the powers of his ſoule, even after ſhe hath left her body, will be ſtill longing after that deare Idoll of her affections; and for the want of it, ſhe will not value the great knowledge ſhe ſhall then be indued withall, nor care for any other good ſhe poſſeſſeth, like a man who being ſorrounded, with a full ſea and ſwolne tide of all ſpecious objects that may pleaſe and delight him, hath by unluckly chance ſuffered his violent affections, and his impotent deſires to be intangled in ſome meane love, that either neglecteth him, or he is hindered from enjoying; and thereby, that little drope of gall, or rather that privation of a meane contentment (which truly in it ſelfe, is nothing) infecteth and poyſoneth the whole draught of happineſſe that but for this, would ſwell him up to the height of his wiſhes.

5. The ſtate of a vitious ſoule in the next life.

But no compariſons of ſorrowes, griefes, or anguiſhes in this life (where our earthly dwelling doth ſo clog, and allay, and dull the ſenſe of our ſoule, which only feeleth and reliſheth either delight or woe) can arrive to ſhadow out the miſery of a ſeparated ſoule ſo affected; whoſe ſtraines are ſo exceſſively vehement, and whoſe nature is a pure activity, and her ſelfe, all ſenſe, all knowledge. It is true, I confeſſe that in a man, ſuch motions doe in part proceed from paſſion: and therefore, I will allow, that ſo much of them, as have their origine meerely and onely from thence, ſhall dye with the body, and ſhall not have made any impreſſion in the ſeparated ſoule: but beſides the ſtreame of paſſion wee may in ſuch motions obſerve alſo, the work of reaſon, for ſhe, both approveth and employeth her powers, to compaſſe and gaine what the other preſenteth, & by legitimate diſcouſe, draweth conſequences out of that principle or judgment, which maketh the byas, it then leaneth unto: and theſe, are undeniable effects of a ſpirituall judgment ſetled in the ſoule. And therefore, as farre as theſe motions proceed from ſpirituall judgements, ſo far, it is cleare they muſt remaine in the ſeparated ſoule.

paradventure

Peradventure, what I have ſaid, may bee lyable to a miſtake; as though I conceived that theſe ſpirituall judgments are made in the ſoule according to right reaſon, and to legitimat diſcourſe: whereas, I meane nothing leſſe; but eſteeming an overſtrong judgement in the ſeperated ſoule, to be proportionable unto a paſſion in the body; I conceite that as paſſion ſetteth reaſon on work to finde out meanes, whereby ſhee may arrive unto her ends; ſo in like manner, may this judgment ſet reaſon on floate, with thoſe acts which follow conſequently upon it (though inconſequent to the whole body of reaſon:) becauſe the diſorder there, is, in the exceſſe of this judgment over others, whoſe force (according to nature) ought to be greater than it. So that, if we would frame a conception of a diſordered ſoule, when it is out of the body; wee may imagine it correſpondent to a body, whoſe one part were bigger then could ſtand in proportion with an other, as, if the hand (to uſe the example wee brought before) were greater than the arme could manage, or the foote were larger and heavyer, then the leg and thigh could wield: unto which adde that every part were active and working of it ſelfe: ſo as, though it could not bee governed, yet would it continually have its owne operation, which would bee contrary to the operation of the arme, or of the legge, and conſequently, it would ever bee tending to incompoſſible operations: and by that meanes, both one member would alwayes diſagree from the other, and neither of them attaine any effect at all; not unlike to the fanſie of the Poets, who fained a monſter, which they termed *Scylla*, whoſe inferiour parts, were a company of dogges, ever ſnarling and quarrailing among themſelves; and yet were unſeverable from one an other, as being compartes of the ſame ſubſtance.

But to declare this important doctrine more dogmatically; let us conſider that of neceſſity a diſordered ſoule hath theſe following judgments ſetled in her. Namely, that ſhee, is not well; that ſhee cannot bee well without her deſired good; that it is impoſſible for her to compaſſe that good; and laſtly, that this ſtate ſhe is in, is by all meanes poſſible to be avoyded; not, by changing her judgment (for that is her ſelfe)

selfe) but by procuring the satisfaction she desireth; and this with all the power, and totall inclination of her activity and possibility. This then, being the temper of a disordered separated soule, it is easie to conceive, what a sad condition such an one remaineth then in; which is infinitely more, then any affliction that can happen to a man in this world: for since, even here, all our joyes and griefes, doe proceed from our soule; wee must needes allow, that when shee shall bee from the burthen of her body (which doth exceedingly impeach, and limit her operations, and activity) all her actions will be then farre greater and more efficacious.

6. The fundamental reason why as wel happinesse as misery is so excessive in the next life.

But because this point is of highest consequence, wee may not slightly passe it over; but we will endeavour, if we can, to discover the wonderfull efficacie and force of a separated soules operations; that from thence wee may the better collect, how great her happinesse or misery will bee in the next life. Let us then consider, how an act or judgment of the soule, may bee more forcible, either by it selfe, or by the multiplication of such helpes, as doe concurre with it. To begin with considering the Act in it selfe, we know that the certainest way to measure the strength of it, is to take a survey of the force which shewveth it selfe in its effect: for the being relatives to one an other, each of them discovereth the others nature, Now, this vve vvill doe after our ordinary manner, by comparing the spirituall effects issuing from a judgement in the soule, to materiall effects proceeding from the operations and motions of bodies. In these we may observe three things, by vvhich we may estimate their efficaciousnesse: some actions dure a longer time; others, take up a greater place, and others againe, worke the like effect in a greater place, and in a shorter time: which last sort, of all others, do proceed from the most powerfull, and most forcible agents. If then in these considerations we compare a separated soule to a body; what an infinity of strength & efficacity, will the meanest of those pure substances have, beyond the most powerfull and active body that can bee imagined in nature? For wee have already shewed how a separated soule comprehendeth at once, all place, and all times: so that, her activity requireth no application

cation to place or time; but, ſhe is, of her ſelfe, miſtreſſe of both, comprehending all quantity whatſoever, in an indiviſible apprehenſion; and ranking all the parts of motion, in their compleate order: and knowing at once, what is to happen in every one of them. On the other ſide; an incorporated ſoule, by reaſon of her being confined to the uſe of her ſenſes, can looke upon but one ſingle definite place, or time, at once; and needeth a long chaine of many diſcourſes to comprehend all the circumſtances of any one action: and yet after all, how ſhort ſhe is of comprehending all? So that comparing the one of theſe with the other, it is evident, that in reſpect of time and place; and in reſpect of any one ſingular action; the proportion of a ſeparated ſoule, to one in the body, is as all time, or all place, in reſpect of any one piece, or leaſt parcell of them; or as the entire abſolute comprehender of all time and all place, is to the diſcoverer of a ſmall meaſure of them. For whatſoever a ſoule willeth in that ſtate, ſhee willeth it for the whole extent of her duration; becauſe ſhe is then out of the ſtate or capacity of changing: and wiſheth for whatſoever ſhe wiſheth, as for her abſolute good; and therefore employeth the whole force of her judgment, upon every particular wiſh. Likewiſe the eminency which a ſeparated ſoule hath over place, is alſo then entirely employed upon every particular wiſh of hers; ſince in that ſtate there is no variety of place left unto her, to wiſh for ſuch good in one place, and to refuſe it in an other; as, whiles ſhe is in the body happeneth to every thing ſhe deſireth. Wherefore, whatſoever ſhe then wiſheth for, ſhe wiſheth for it according to her compariſon unto place: that is to ſay; that as ſuch a ſoule hath a power to worke at the ſame time in all place by the abſolute comprehenſion, which ſhe hath of place in abſtract: ſo every wiſh of that ſoule, if it were concerning a thing to be made in place, were able to make it in all places; through the exceſſive force & efficacy wch ſhe emploieth upon every particular wiſh

The third effect by which among bodyes we gather the vigour, and energy of the cauſe that produceth it, (to witte, the doing of the like action, in a leſſer time and in a larger extent,) is but a combination of the two former: and therefore, it requireth no further particular inſiſtance upon it, to ſhew, that likewiſe in this, the proportion of a ſeparated to an incorporated

ſoule

ſoule, muſt needs be the ſelfe ſame as in the others; ſeeing that a ſeparated ſoules actívity, is upon all place in an indiviſible of time

Therefore to ſhutt up this point; there remaineth only for us to conſider, what addition may be made unto the efficacity of a judgement, by the concurrence of other extrinſicall helps. We ſee that when an underſtanding man will ſettle any judgement, or concluſion in his minde, he weigheth throughly all that followeth out of ſuch a judgement; and conſidereth likewiſe all the antecedents that lead him unto it: and if after due reflection, and examination, of whatſoever concerneth this concluſion which he is eſtabliſhing in his mind, he findeth nothing to croſſe it, but that every particular and circumſtance goeth ſmoothly along with it, and ſtrengtheneth it; he is then ſatisfied, and quiet in his thoughts, and yeeldeth a full aſſent thereunto: which aſſent is the ſtronger, by how many the more concurrent teſtimonyes he hath for it. And although he ſhould have a perfect demonſtration or ſight of the thing in it ſelfe, yet every one of the other extrinſecall prooſes, being as it were a new perſwaſion, hath in it a further vigour to ſtrengthen and content his mind in the forehad demonſtration: for, if every one of theſe be in it ſelfe ſufficient to make the thing evident; it can not happen that any one of them, ſhould hinder the others: but contrariwiſe, every one of them muſt needs concurre with all the reſt, to the effectuall quieting of his underſtanding, in its aſſent, to that judgement. Now then, according to this rate, let us calculate, (if we can) what concurrence of prooſes and witneſſes a ſeparated ſoule will have to ſettle and ſtrengthen her in every one of her judgements. We know, that all verities are chained and connected one to another; and that there is no true concluſion ſo far remote from any other, but may by more, or leſſe conſequences and diſcourſes, be deduced evidently out of it: it followeth then that in the abſtracted ſoule, where all ſuch conſequences are ready drawne, and ſeene in themſelves without extention of time or employing of paines to collect them; every particular verity, beareth teſtimony to any other ſo that every one of them is beleeved, and worketh in the ſence and vertue of all. Out of which it is manifeſt, that every judgement in ſuch a ſeparated ſoule, hath an infinit ſtrength and effecacity over any, made by an embodyed one. To

To ſumme all up in a few words: we finde three rootes of infinity in every action of a ſeparated ſoule, in reſpect of one in the body: firſt, the freedome of her eſſence or ſubſtance in it ſelfe: next, that quality of hers, by which ſhe comprehendeth place and time; that is, all permanent and ſucceſſive quantity: and laſtly, the concurrence of infinite knowledges to every action of hers. Having then this meaſure in our hands, let us apply it to a well ordered, and to a diſordered ſoule paſſing out of this world: let us conſider the one of them, ſet upon thoſe goods, which ſheeſhall there have preſent, and ſhall fully enjoy: the other, languiſhing after, and pining away for thoſe, which are impoſſible for her ever to obtaine. What joy, what content, what exultation of mind, in any living man, can be conceived ſo great, as to be compared with the happineſſe of one of theſe ſoules? And what griefe, what diſcontent, what miſery can be like the others?

7. The reaſon why mans ſoule requireth to bee in a body, and to live for ſome ſpace of time joyned with it.

Theſe are the different effects, which the divers manners of living in this world, doe cauſe in ſoules after they are delivered from their bodies: out of which, and out of the diſcourſe that hath diſcovered theſe effects unto us, we ſee a cleare reſolution of that ſo maine and agitated queſtion among the Philoſophers, why a rationall ſoule is impriſoned in a groſſe body of fleſh and bloud? In truth, the queſtion is an illegitimate one; as ſuppoſing a falſe ground: for the ſoules being in the body, is not an impriſonment of a thing that was exiſtent, before the ſoule and body met together; but her being there, is the naturall courſe of beginning that, which can no other way come into the liſts of nature: for ſhould a ſoule, by the courſe of nature, obtaine her firſt beeing without a body, eyther ſhe would in the firſt inſtant of her being, be perfect in knowledge, or ſhe would not: if ſhe were, then would ſhe be a perfect and compleat immateriall ſubſtance, not a ſoule; whoſe nature is to bee a compartner to the body, and to acquire her perfection by the mediation and ſervice of corporeall ſenſes: but if ſhee were not perfect in ſcience, but were only a capacity thereunto, and like unto white paper, in which nothing were yet written; then unleſſe ſhee were put into a body, ſhe could never arrive to know any thing, becauſe motion and alteration are effects peculiar to bodies: therefore, it muſt be agreed, that ſhe is naturally deſigned to be in a body: but her being in a body, is her being one thing with the body, ſhe is ſaid to

be in: and so she is one part of a whole, which from its weaker part is determined to be a body.

Againe, seeing that the matter of any thing, is to bee prepared, before the end is prepared, for which that matter is to serve; according to that Axiome *Quod est primum in intentione, est ultimum in executione*: we may not deny, but that the body is in being, some time before the soule: or at the least, that it existeth as soone as she doth: and therefore, it appeareth wholy unreasonable, to say, that the soule was first made out of the body, and was afterwards thrust into it; seeing that the body was prepared for the soule before, or at the least, as soone as she had any beginning: and so we may conclude, that of necessity the soule must be begunne, layed, hatched, and perfected in the body.

And although it bee true, that such soules, as are seperated from their bodies, in the first instant of their being there, are notwithstanding imbued with the knowledge of all things; yet is not their longer abode there in vaine: not onely, because thereby the species is multiplyed; (for nature is not content with barely doing that, without addition of some good to the soule it selfe) but as we for the wonderfull, and I may say infinite advantage, that may thereby accrew to the soule, if she make right use of it: for, as any act of the abstracted soule is infinit, in comparison of the acts which men exercise in this life, (according to what we have already shewed) so by consequence, must any increase of it, be likewise infinite: and therefore we may conclude, that a long life well spent, is the greatest and most excellent gift, which nature can bestow upon a man.

8. That the misery of the soule in the next world, proceedeth out of inequalitie, and not of falsity of her judgements.

The unwary reader may perhapps have difficulty, at our often repeating of the infelicity of a miserable soule; since wee say that it proceedeth out of the judgements, shee had formerly made in this life; which without all doubt were false ones: and nevertheless, it is evident, that no false judgements, can remaine in a soule, after she is separated from her body; as we have above determined. How then can a soules judgements, be the cause of her misery? But the more heedefull reader, will have noted, that the misery which wee put in a soule, proceedeth out of the inequality, not out of the falsity, of her judgements: for if a man bee inclined to a lesser good, more then to a greater, he will in action betake himselfe to the lesser good,

good, and desert the greater, (wherein, neither judgement it false, nor either inclination is naught) meerely out of the improportion of the two inclinations or judgements to their objects: for that a soule may be duely ordered, and in a state of being well, shee must have a lesser inclination to a lesser good, and a greater inclination to a greater good: and in pure spirits, these inclinations are nothing else, but the strength of their judgements: which judgements in soules, whiles they are in their bodies, are made by the repetition of more acts from stronger causes, or in more favourable circumstances. And so it appeareth, how without any falsity in any judgement, a soule may become miserable, by her conversation in this world; where all her inclinations generally are good, unlesse the disproportion of them, do make them bad.

## THE TWELFTH CHAPTER.

*Of the perseverance of a soule, in the state shee findeth her selfe in, at her first separtion from her body.*

THus wee have brought mans soule, out of the body she lived in here, and by which she conversed, and had commerce with the other parts of this world: and we have assigned her, her first array and stole, with which she may be seene in the next world: so that now there remaineth onely for us to consider, what shall betide her afterwards; and whether any change may happen to her, and bee made in her, after the first instant of her being a pure spirit, separated from all consortshippe with materiall substances. To determine this point the more clearely, let us call to minde, an axiome that Aristotle giveth us in his logicke; which teacheth us, *That as it is true, if the effect be, there is a cause; so likewise it is most true, that if the cause be in act, or causing, the effect must also be.* Which *Axiome* may be understood two waies: the one, that if the cause hath its effect, then the effect also is: and this is no great mistery, or for it, are any thankes due to the teacher; it being but a repetition, and saying over againe of the same thing. The other way is, that if the cause bee perfect in the nature of being a cause, then the effect is: which is as much as to say, that if nothing be wanting to the cause, abstracting precisely from the effect; then neither is

1. The explication, and proofe of that maxime, that, if the cause be in act, the effect must also be.

the effect wanting. And this is the meaning of Aristotles Axiome: of the truth and evidence whereof in this sense, if any man should make the least doubt, it were easie to evince it: as thus, if nothing be wanting but the effect, and yet the effect doth not immediatly follow, it must needs be, that it cannot follow at all; for if it can, and doth not, then something more must bee done to make it follow: which is against the supposition, that nothing was wanting but the effect; for that which it is to be done, was wanting. To say, it will follow without any change, is senseless: for if it follow without change, if followeth out of this, which is already put: but if it doe follow out of this which is precisely put, then it followeth, against the supposition, which was, that it did not follow, although this were put.

2. The effects of all such agents as worke instantaneously, are compleat in the first instant that the agents are put,

This then being evident, let us apply it to our purpose; and let us put three or more things, namely A. B. C. and D: whereof none can worke otherwise, then in a instant or indivisibly: and I say, that whatsoever these foure things are able to doe, without respect to any other thing besides them, is compleatly done in the first instant of their being put: and if they remaine for all eternity, without communication or respect to any other thing, there shall never be any innovation in any of them, or any further working among them: but they will alwaies remaine immutable, in the same state they were in, at the very first instant of their being put: for what soever A. can doe, in the first instant, is in that first instant actually done; becaus he worketh indivisibly: and what can be done precisely by A. and by his action joyned to B. doth precisely follow out of A. and his action, and out of B, and his action, if B. have any action independent of A. and becaus all these are in the same instant, whatsoever followeth precisely out of these, and out of any thing else that is in the same instant, and that worketh indivisibly as they doe; is necessarily done in that very instant; but all the actions of C. and D. and of whatsoever by reflection from them may be done by A. and B. being all of them indivisible, and following precisely out of some of the forenamed actions; they doe follow out of things being in this instant: and becaus they are indivisible, they may be in this instant: and therefore, all is done in this instant. Now, supposing all to be done that can bee done by them in this instant; and that nothing can follow from them, unless it follow precisely out of what is in this instant; and that it is all indivisible:

it

it followeth clearely, that whatsoever (concerning them) is not in this instant, can never be.

These two conclusions being thus demonstrated; let us in the next place determine, how all actions of pure spirits, which have no respect to bodies, must of necessity be indivisible; that is, must include no continuate succession: by which, I meane such a succession, as may be divided into parts without end: for if wee looke well into it, wee shall finde, that a continuate succession cannot bee a thing, which hath in it selfe a *Being*: and the reason is, because the essence of such a succession, consisteth in having som of its parts already passed, and others of them yet to come: but on the other side, it is evident, that no such thing can bee, whose essentiall ingredients are not it selfe: and therefore it followeth evidently, that such a thing as we call succession, can have no being in it selfe: seeing that one essentiall part of it, never is with the other: therefore, such a succession, must have its being in some permanent thing, which must bee divisible; for that is essentially required in succession: but permanent divisibility is that, which wee call Biggenesse or Quantity; from which pure spirits are free: and therefore, it is most evident, that all their actions in respect of themselves, are absolutely indivisible.

3. All pure spirits doe worke instantaneously.

Now, to make use of this doctrine to our intent: we say, that since our soule, when it is separated from our body, is a pure spirit or understanding; and that all her actions are indivisible; and that all actions of other spirits upon her must likewise be such; and by consequence, that there can be no continuate succession of action among them: wee must of necessity conclude, that according to the private nature of the soule, and according to the common notion of spirituall things; there can bee no change made in her, after the first instant of her parting from her body: but, what happinesse or misery betideth her in that instant, continueth with her for all eternity. Yet it is not my minde to say, that by the course of the universall resolutions, from which she is not wholy exempt, & from supernaturall administration of corporall things, there may not result some change in her. But the consideration of that matter, I remitt to those treatises, unto which it belongeth; as not depending, nor ensuing from the particular nature of the soule: and therefore, not falling under our discussion in this place.

4. That a soule separated from her body can not suffer any change after the first instant of her separation.

This same conclusion may bee proved by an other argu-

ment, beſides this which we have now uſed; and it is this. Whatſoever worketh purely by underſtading and minde, cannot bee changed in its operations, unleſſe its underſtanding or minde be altered: but this cannot happen, unleſſe eyther it leane ſomewhat, it knew not before; or forgetting a foreknowne truth, it beginne afterwards to thinke a falſity. This ſecond part, is impoſſible, as wee have already ſhewed, when we proved that falſehood could have no admittance into a ſeparated ſoule: and the former is as impoſſible; it being likewiſe proved, that at her firſt inſtant of her ſeparation, ſhe knoweth all things: wherefore, we may hence confidently conclude, that no change of minde, (that is no change at all) can happen to an abſtracted ſoule.

5. That temporall ſinnes are juſtly puniſhed with eternall paines.

And thus, by diſcourſe, we may arrive, to quit our ſelves eaſily of that famous objection, ſo much peſtering Chriſtian Religion; how God, can in juſtice impoſe eternall paines upon a ſoule, for one ſinne, acted in a ſhort ſpace of time. For we ſee, it followeth by the neceſſary courſe of nature, that if a man die in a diſorderly affection to any thing, as to his chiefe good, hee eternally remaineth by the neceſſity of his owne nature, in the ſame affection: and there is no imparity, that to eternall ſinne, there ſhould bee impoſed eternall puniſhment.

THE

# THE CONCLVSION.

AND now I hope, I may confidently say, I have been as good as my word: and I doubt not, but my Reader will finde it so, if he spend but halfe as much time in perusing these two treatises, as the composing them hath cost me. They are too nice (and indeede, unreasonable) who expect to attaine without paines, unto that, which hath cost others, yeares of toyle. Let us carefully pursue the hidden bounties he hath treasured up for us. Let them remember the words of holy *Job*, that *wisedome is not found in the hand of those, that live at their ease.* Let them cast their eyes on every side round about them, and then tell me, if they meet with any employment, that may bee compared to the attaining unto these, and such like principles; whereby a man is enabled to governe himselfe understandingly and knowingly, towards the happinesse, both of the next life and of this; and to comprehend the wisemans theme; *what is good for a man in the dayes of his vanity, whiles he playeth the stranger under the sunne.* Let us feare Gods Judgements. Let us thanke him for the knowledge he hath given us: and admire the excellency of Christian Religion; which so plainely teacheth us that, unto which it is so extreme hard to arrive by naturall meanes. Let us blesse him, that we are borne unto it. And let us sing to him; *That it is he, who preacheth his doctrine to Jacob, and giveth his lawes to Israel. He hath not done the like to all nations; nor hath hee manifested his secret truths unto them.*

BUt before I cut of this thread, which hath cost mee so much paines to spinne out to this Length; I must crave my Readers leave, to make some use of it, for my owne behoofe. Hitherto my discourse hath beene directed to him: now I shall entreate his patience, that I may reflect it in a word or two upon my selfe. And as I am sure I have profited my selfe not a little, by talking all this while to him, that obliging me to polish my conceptions with more care, and to range them into better order, then whiles they were but rude meditations within my owne breast; so I hope, that a little con-

converſation with my ſelfe upon this important ſubject, (which is to be ſtudied for uſe, and practiſe; not for ſpeculative ſcience) may prove advantagious unto him; if his warmed thoughts have turned his ſoule to ſuch a key, as I am ſure theſe conſiderations have wound up mine unto.

To thee then my ſoule, I now addreſſe my ſpeech. For ſince by long debate, and toyleſome rowing againſt the impetuous tydes of ignorance, and falſe apprehenſions, which overflow thy bankes, & hurry thee headlong down the ſtreame, whiles thou art impriſoned in thy clayie manſion; we have with much adoe arrived to ayme at ſome litle atome of thy vaſt greatneſſe; and with the hard and tough blowes of ſtrict and wary reaſoning, wee have ſtrucken out ſome few ſparkes of that glorious light, which invironeth and ſwelleth thee, or rather, which is thee: it is high time, I ſhould retire my ſelfe out of the turbulent & ſlippery field of eager ſtriſe and litigious diſputation, to make my accounts with thee; where no outward noiſe may diſtract us, nor any way intermeddle between us, excepting only that eternall verity, which by thee ſhineth upon my faint and gloomy eyes; and in which I ſee, whatſoever doth or can content thee in me. I have diſcovered, that thou (my ſoule) wilt ſurvive me: and ſo ſurvive mee, as thou wilt alſo ſurvive the mortality, and changes which belong to me; and which are but accidentary to thee, meerely becauſe thou art in me. Then ſhall the viciſſitude of time, and the inequality of diſpoſitions in thee, be turned into the conſtancy of immortality; and into the evenneſſe of one being, never to end, and never to receive a change, or ſucceſſion to better or worſe.

When my eye of contemplation hath beene fixed upon this bright ſunne, as long as it is able to endure the radiant beames of it; whoſe redundant light veyleth the looker on, with a darke miſt: let me turne it for a little ſpace, upon the ſtraight paſſage, and narrow gullet, through which thou ſtriveſt (my ſoule) with faint and wearie ſteppes, during thy hazardous voyage upon the earth, to make thy ſelfe away: and let me examine, what compariſon there is, between thy two conditions; the preſent one, wherein thou now findeſt thy ſelfe immerſed in fleſh and blood; and the future ſtate that will betide thee, when thou ſhalt bee melted out of this groſſe oare, and refined from this meane alloy. Let my terme of life, be of a thouſand long yeares; longer then ever happened to our aged forefathers, who ſtored the earth with their numerous progeny,

progeny, by out living their skill to number the diffuſed multitudes that ſwarmed from their loynes: let me, during this long ſpace, be ſole Emperour and abſolute Lord, of all the huge globe of land and water, encompaſſed with Adams offspring: let all my ſubjects lye proſtrate at my feet, with obedience and awe, diſtilling their activeſt thoughts, in ſtudying day and night to invent new pleaſures and delight for me: let nature conſpire with them, to give me a conſtant and vigorous health; a perpetuall ſpring of youth, that may to the full, reliſh whatſoever good all they can fancy: let graveſt Prelates, and greateſt Princes, ſerve in ſtead of flatterers to highten my joyes; and yet thoſe joyes, be raiſed above their power of flattery: let the wiſedome of this vaſt family (whoſe ſentiments, are maximes and oracles, to governe the worlds beliefes and actions) eſteeme, reverence, and adorne me in the ſecreteſt, and the moſt recluſe withdrawings of their hearts: let all the wealth, which to this very day, hath ever beene torne out of the bowels of the earth; and all the treaſures, which the ſea hideth from the view of greedy men, ſwell round about me; whilſt all the world beſides, lyeth gaping to receive the crummes, that fall neglected by me, from my full loaden table: let my imagination bee as vaſt, as the unfathomed Univerſity; and let my felicity be as accompliſhed, as my imagination can reach unto; ſo that following in pleaſure, I be not able to thinke how to increaſe it, or what to wiſh for more, then that which I poſſeſſe and enjoy.

Thus when my thoughts are at a ſtand, and can raiſe my preſent happineſſe no higher; let me call to minde, how this long leaſe of pleaſant dayes, will in time come to an end: this bottome of a thouſand joyfull yeares, will at length bee unwound, and nothing remaine of it: and then (my ſoule) thy infinitely longerlived Immortality will ſucceed; they never ending date, will beginne a new account, impoſſible to be ſummed up, and beyond all proportion infinitely exceeding the happineſſe, we have rudely aymed to expreſſe: ſo that no compariſon can be admitted betweene them. For, ſuppoſe firſt that ſuch it were, as the leaſt and ſhorteſt of thoſe manifold joyes, which ſwell it to that height we have fancyed, were equall to all the contentment thou ſhould'ſt enjoy in a whole million of yeares; yet millions of yeares may be ſo often multiplyed, as at length, the ſlender and limited contentments ſuppoſed in them, may equalyſe, and outgoe the whole heape of overflowing bliſſe,

raiſed ſo high, in the large extent of theſe thouſand happie yeares. Which when they are caſt into a totall ſumme; and that I compare it, with the unmeaſurable eternity, which onely meaſureth thee; then I ſee, that all this huge product of Algebraicall multiplycation, appeareth as nothing, in reſpect of thy remayning, and never ending ſurvivance; and is leſſe, then the leaſt point in regard of the immenſe Vniverſe. But then, if it bee true (as it is moſt true) that thy leaſt ſparke and moment of reall happineſſe, in that bleſſed eternity thou hopeſt for, is infinitely greater, and nobler, then the whole maſſe of fancyed joyes, of my thouſand yeares life here on earth; how infinitely will the value of thy duration exceede all proportion, in regard of the felicity, I had imagined my ſelfe? And ſeeing there is no proportion betweene them, let mee ſadly reflect upon my owne preſent condition: let me examine what it is, I ſo buſily, and anxiouſly, employ my thoughts and pretious time upon: let me conſider my owne courſes, and whether they leade me: let me take a ſurvay of the lives, and actions, of the greateſt part of the world, which make ſo loude a noyſe about my eares: and then may I juſtly ſigh out from the bottome of my anguiſhed hart; to what purpoſe have I hitherto lived? To what purpoſe are all theſe millions of toyleſome auntes, that live and labour about me? To what purpoſe were Ceſars and Alexanders? To what purpoſe Ariſtotles and Archimedes? How miſerably fooliſh are thoſe conquering tyrants, that divide the world with their lawleſſe ſwords? What ſenſeleſſe idiots thoſe acute Philoſophers, who teare mens witts in pieces, by their different waies, and ſubtile Logicke; ſtriving to ſhew men beatitudes in this world, and ſeeking for that, which if they had found, were but a nothing of a nothing in reſpect of true beatitude? He onely is wiſe, who neglecting all that fleſh and blood deſireth, endeavoreth to purchaſe at any rate this felicity, which thy ſurvivance promiſeth: the leaſt degree of which, ſo farre ſurmounteth all the heapes, which the Gyants of the earth are able to raiſe, by throwing hils upon hils, and ſtriving in vaine to ſcale and reach thoſe eternities, which reſide about the skyes. Alaſſe how fondly doth mankind ſuffer it ſelfe to be deluded? How true it is, that the onely thing neceſſary, proveth the only that is neglected? Looke up my ſoule, and fixe thine eye upon that truth, which eternall light maketh ſo cleare unto thee, ſhining upon thy face with ſo great evidence, as defyeth the noonetyde ſunne, in its greateſt brightneſſe.

And

And this it is, that every action of thine, bee it never so slight, is mainely mischievous; or bee it never so bedeckt, with those specious considerations, which the wise men of the world judge important, is foolish, absurd, and unworthy of a man; and unworthy of one that understandeth, and acknowledgeth thy dignity; if in it there be any specke; or if through it, there appeare any sparke of those meane and flat motives, which with a false byas, draw any way aside, from attaining that happinesse, we expect in thee. That happinesse, ought to bee the end, and marke wee levell at: that, the rule and model of all our actions: that, the measure of every circumstance, of every atome, of whatsoever we bestow so pretious a thing upon, as the employment of thee is.

But we must not so slightly passe over the intensenesse and vehemence of that felicitie which thou (my soule) shalt injoy, when thou art severed from thy benumming compartner. I see evidently, that thou dost not survive, a simple and dull essence; but art replenished with a vast and incomprehensible extent of riches and delight within thy selfe. I see that golden chayne, which here by long discourses, filleth huge volumes of Bookes, and diveth into the hidden natures of severall bodies: in the resumed into one circle or linke, which containeth in it selfe the large scope of whatsoever screwing discourse can reach unto. I see it comprehend, and master the whole world of bodies. I see every particular nature, as it were imbossed out to the life, in thy celestiall garment. I see every solitary substance ranked in its due place and order, not crushed or thronged by the multitude of its fellowes; but each of them in its full extent, in the full propriety of every part and effect of it; and distinguished into more divisions, then ever nature severed it into. In thee I see an infinite multitude enjoy place enough. I see, that neither hight, nor profundity, nor longitude enough, nor latitude, are able to exempt themselves from defused powers: they saddome all; they comprehend all; they master all, they inrich thee with the flocke of all; and thou thy selfe art all, and somewhat more then all; and yet, now but one of all. I see, that every one of this all, in thee encreaseth the strength, by which thou knowest any other of the same all: and all, encreaseth the knowledge of all, by a multiplycation beyond the skill of Arithmeticke; being (in its kinde) absolutely infinite; by having a nature, that is incapable of being eyther infinite or finite. I see againe, that those things which have

not knowledge, are ſituated in the loweſt, and meaneſt rancke of creatures; and are in no wiſe comparable to thoſe which know. I ſee, there is no pleaſure at all, no happineſſe, no felicity, but by knowledge, and in knowledge. Experience teacheth me, how the purer, and nobler race of mankind, adoreth in their hearts, this idoll of knowledge, and ſcorneth what ever elſe they ſeeme to court, and to be fond of. And I ſee, that this exceſſe of ſea of knowledge which is in thee, groweth not by the ſucceſſion of one thought after another; but it is like a full ſwolne ocean, never ebbing on any coaſt, but equally puſhing at all its bounds, and tumbling out its flowing waves on every ſide, and into every creche; ſo that every where it maketh high tide. Or like a pure ſunne, which from all parts of it ſhooteth its radiant beames with a like extreamity of violence. And I ſee likewiſe, that this admirable knowledge, is not begotten & conſerved in thee, by the accidentary helpe of defective cauſes; but is rooted in thy ſelfe; is ſteeped in thy owne eſſence, like an vnextinguiſhable ſourſe of a perpetually ſtreaming fire; or like the living head of an everrunning ſpring; beholding to none, out of thy ſelfe, ſaving only to thy Almighty Creatour; and begging of none; but being in thy ſelfe all that of which thou ſhouldeſt begge.

This then (my ſoule) being thy lott; and ſuch a hieght of pleaſure being reſerved for thee; and ſuch an extremity of felicity, within a ſhort ſpace attending thee; can any degenerate thought, ever gaine ſtrength enough, to ſhake the evidence which theſe conſiderations implant and rivet in thee? Can any dull oblivion deface this ſo lively and ſo beautifull image? Or can any length of time, draw in thy memory a veyle betweene it, and thy preſent attention? Can any perverſity, ſo diſtort thy ſtraight eyes, that thou ſhouldeſt not looke alwaies fixed upon this marke; and levell thy ayme directly at this white? How is it poſſible, that thou canſt brooke to live, and not expire preſently, thereby to ingulfe thy ſelfe, and bee throughly imbibed with ſuch an overflowing bliſſe? Why doſt thou not breake the walles and the chaynes of thy fleſh and bloud, and leape into this glorious liberty? Here Stoickes, you are to uſe your ſwords. Vpon theſe conſiderations, you may juſtifie the letting out the blood, which by your diſcourſes, you ſeeme ſo prodigall of. To die upon theſe termes, is not to part with that, which you fondly call happie life; feeding your ſelves, and flattering your

hearts

hearts with empty words: but rather it is, to plunge your ſelves into a felicity, you were never able to imagine, or to frame it to your miſguided thoughts any ſcantling of.

But nature pulleth me by the eares, and warneth me from being ſo wrongfull to her, as to conceive, that ſo wiſe a governeſſe ſhould to no advantage, condemne mankinde ſo long a baniſhment, as the ordinary extent of his dull life, and weariſome pilgrimage here under the ſunne reacheth unto. Can we imagine, ſhee would allow him ſo much layſie time, to effect nothing in? Or can wee ſuſpect that ſhee intended him no further advantage, then what an abortive child arriveth unto in his mothers wombe? For whatſoever the netts and toyles of diſcouſe can circle in; all that he, who but once knoweth that himſelfe is, can attaine unto as fully, as hee that is enriched with the ſcience of all things in the world. For the connexion of things, is ſo linked together, that proceeding from any one, you reach the knowledge of many; and from many, you cannot faile of attaining of all: ſo that a ſeparated ſoule, which doth but know her ſelfe, cannot chuſe but know her body too; and from her body, ſhee cannot miſſe in proceeding from the cauſes of them both, as farre as immediate cauſes doe proceede from others over them: and as litle can ſhee bee ignorant, of all the effects of thoſe cauſes ſhe reacheth unto. And thus, all that huge maſſe of knowledge, and happineſſe which we have conſidered in our laſt reflection, amounteth to no more, then the fillieſt ſoule buried in warme bloud, can and will infallibly attaine unto, when its time commeth. We may then aſſure our ſelves, that juſt nature hath provided and deſigned a greater meaſure of ſuch felicity for longer livers: and ſo much greater, as may well be worth the paines and hazards, of ſo miſerable and tedious a paſſage, as here (my ſoule) thou ſtruggleſt through. For certainely, if the dull perſecution, which by natures inſtitution, hammereth out a ſpirituall ſoule from groſſe fleſh and bloud, can atcheive ſo wondrous an effect, by ſuch blunt inſtruments, as are uſed in the contriving of a man: how can it bee imagined, but that fifty or a hundred yeares beating upon far more ſubtile elements, refined in ſo long a time, as a child is becomming a man, and arriving to his perfect diſcourſe, muſt neceſſarily forge out in ſuch a ſoule, a ſtrange and admirable excellency, about the unlicked forme of an abortive embryon? Surely thoſe innumerable ſtrokes (every one of which maketh a ſtrong impreſſion in the ſoule,

upon whom they beate) cannot chooſe but worke a mighty difference, in the ſubject that receiveth them, changing it ſtrangely from the condition it was in, before they begun to new mould it. What if I ſhould ſay, the odds betweene two ſuch ſoules, may peradventure bee not unlike the difference, betweene the witts and judgements of the ſubtileſt Philoſopher that ever was, and of the dulleſt childe or idiote living. But this compariſon falleth too ſhort by farre: even ſo much, that there is no reſemblance or proportion betweene the things compared: for as the exceſſe of great numbers over one another, drowneth the exceſſe of ſmall ones, and maketh it not conſiderable, in reſpect of theirs, although they ſhould bee in the ſame proportion; ſo the advantages of a ſoule, forged to its higheſt perfection in a mans body, by its long abode there, and by its making right uſe of that pretious time allowed it; muſt needs (in poſitive valew, though not in geometricall proportion) infinitly exceede, when it ſhall be delivered out of priſon, the advantages, which the newly hatched ſoule of an abortive infant ſhall acquite, at the breaking of its chaines. In this caſe, I beleeve no man would be of Cæſars minde; when he wiſhed to bee rather the firſt man in a contemptible poore village, hee paſſed through among the deſert mountaines, then the ſecond man in Rome. Let us ſuppoſe, the wealth of the richeſt man in that barren habitation, to be one hundred Crownes; and that the next to him in ſubſtance, had but halfe ſo much as he: in like manner, in that opulent Citie, the head of the world, where millions were as familiar as pence in other places, let the exceſſe of the richeſt mans wealth, be but (as in the former) double over his, that commeth next unto him; and there you ſhall finde, that if the pooreſt of the two, be worth fifty millions, the other hath fifty millions more then he: whereas the formers petty treaſure, exceedeth his neighbours but by fifty crownes. What proportion is there, in the common eſtimation of affaires, between that triviall ſumme, and fifty millions? Much leſſe is there, between the excellency of a ſeparated ſoule, firſt perfected in its body, and another that is ſet looſe into compleate liberty, before its body arrived in a naturall courſe, to be delivered into this world, and by its eye to enjoy the light of it. The change of every ſoule at its ſeparation from the body, to a degree of perfection, above what is enjoyed in the body, is in a manner infinite: and by a like infinite proportion, every degree of perfection it had in the body, is alſo then multiplyed:

ed: what a vaſt product then of infinity, muſt neceſſarily be raiſed, by this multiplying inſtant of the ſoules attaining liberty, in a well moulded ſoule; infinitly beyond that perfection, which the ſoule of an infant dying before it be borne, arriveth unto? And yet wee have determined that to bee in a manner infinite. Here our skill of Arithmeticke and proportions fayleth us. Here we find infinite exceſſe, over what we alſo know to bee infinite. How this can bee the feeble eyes of our limited underſtanding, are too dull to penetrate into: but that it is ſo, we are ſure: the rigour of diſcourſe, conviniceth and neceſſarily concludeth it. That aſſureth us, that ſince every impreſſion upon the ſoule, while it is in its body, maketh a change in it; were there no others made, but meerely the iterating of thoſe acts, which brought it from ignorance to knowledge; that ſoule, upon which a hundred of thoſe acts had wrought, muſt have a hundred degrees of advantage over an other, upon which onely one had beaten; though by that one, it had acquired perfect knowledge of that thing: and then in the ſeparation, theſe hundred degrees, being each of them infinitely multiplyed, how infinitely muſt ſuch a ſoule exceed in that particular, (though wee know not how) the knowledge of the other ſoule; which though it be perfect in its kind, yet had but one act to forge it out? When we arrive to underſtand the difference of knowledge, betweene the ſuperiour and inferiour rankes of intelligences; among whom, the loweſt knoweth as much as the highſt; and yet the knowledge of the higheſt, is infinitely more perfect and admirable, then the knowledge of his inferiours: then, and not before, we ſhall throughly comprehend this myſtery. In the meane time, it is enough for us, that we are ſure, that thus it faireth with ſoules: and that by how much the excellency and perfection of an all-knowing and all-comprehending ſoule, delivered out of the body of a wretched embryon, is above the vileneſſe of that heavie lumpe of fleſh, it lately quited in his mothers wombe; even by ſo much, and according to the ſame proportion, muſt the excellency of a compleate ſoule (compleated in its body) be in a pitch above the adorable majeſty, wiſedome, and auguſtneſſe, of the greateſt and moſt admired oracle in the world, living embodyed in fleſh and bloud. Which as it is in a height, and eminency over ſuch an excellent and admirable man, infinitely beyond the exceſſe of ſuch a man, over that ſilly lumpe of fleſh, which compoſeth the moſt contemptible idiote or embryon; ſo likewiſe, is the exceſſe

ceſſe of it, over the ſoule of an abortive embryon, (though by the ſeparation, growne never ſo knowing, and never ſo perfect) infinitly greater, then the dignity and wiſedome of ſuch a man, is above the feebleneſſe and miſerie of a new animated child. Therefore have patience my ſoule: repine not at thy longer ſtay here in this vaile of miſery, where thou art baniſhed from thoſe unſpeakeable joyes thou ſeeſt at hand before thee. Thou ſhalt have an overflowing reward for thy enduring and patienting in this thy darkſome priſon. Deprive not thy ſelfe through miſchievous haſt, of the great hopes and admirable felicity that attend thee, canſt thou but with due temper ſtay for it. Be content to let thy ſtock lye out a while at intereſt; thy profits wil come in vaſt proportions; and every yeare, every day, every houre, will pay thee intereſt upon intereſt: and the longer it runneth on, the more it multiplyeth: and in the account thou ſhalt finde, if thou proceedeſt as thou ſhouldeſt, that one moment oftentimes bringeth in a greater increaſe unto thy ſtocke of treaſure, then the many yeares thou didſt live and trade before: and the longer thou liveſt, the thicker will theſe moments arrive unto thee. In like manner as in Arithmeticall numeration, every addition of the leaſt figure, multiplyeth the whole ſome it findeth. Here thou wilt prove how true that rich man ſaid, who of his gaines pronounced, that hee had gotten little with great labour, and great ſummes with little: ſo if thou beſtoweſt well thy time, thy latter ſummes will bring thee in huge accounts of gaine, upon ſmall expence of paines or imployments; whereas thy firſt beginnings are toyleſome and full of paine, and bring in but ſlender profit.

By this time, my ſoule, I am ſure thou art ſatisfied, that the exceſſe of knowledge & of pleaſure, which thou ſhalt enjoy, is vaſtly beyond any thou art capeable of here. But how may we eſteeme the juſt proportion they have to one another? Or rather is not the pleaſure of a ſeparated ſoule, ſo infinitly beyond all that can be reliſhed by one embodied here in clay, that there is no proportion betweene them? At the leaſt, though we are not able to meaſure the one, let us doe our beſt to ayme and gueſſe at the improportion betweene them; and rejoyce that we finde that it is beyond our reach to conceive or immagine any thing, nigh the truth & the huge exceſſe of thy good (my ſoule) over the moſt I am capeable of in this world. It is agreed, that the vehemence and intenſeneſſe of any pleaſure, is proportionable to the activity, power, and energy of the ſubject, which

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is affected with ſuch pleaſure; and to the gravitation, bent, and greatneſſe, that ſuch a ſubject hath to the object that delighteth it. Now to rove at the force and activity, wherewith a ſeparated ſoule weigheth and ſtriveth to joyne it ſelfe, to what its nature carrieth it unto; let us beginne with conſidering the proportions of celerity and forcibleneſſe, wherewith heavie bodies move downewards. I ſee a pound weight in one ſcale of the ballance, weigheth up the other empty one with great celerity. But if into that you imagine a million of pounds to be put, you may well conceive, that this great exceſſe, would carry up the ſingle pound weight with ſo much violence and ſpeed, as would hardly afford your eye liberty to obſerve the velocity of the motion. Let me multiply this million of pounds by the whole globe of the earth; by the vaſt extent of the great orbe, made by the ſonnes, or earthes motion about the center of the world; by the incomprehenſibility of that immenſe ſtore-houſe of matter and of bodies, which is deſigned in lumpe by the name of the Vniverſe; of which we know no more, but that it is beyond all hope of being knowne, during this mortall life. Thus when I have heaped together a bulke of weight, equall to this unwieldy machine; let me multiply the ſtrength of its velocity, and preſſure over the leaſt atome imaginable in nature, as farre beyond the limits of gravity, as the ingenious skill, wherewith Archimedes numbred the leaſt graines of ſand that would fill the world, can carry it: and when I have thus wearied my ſelfe, and exhauſted the power of Arithmetick, and of Algebra, I finde there is ſtill a proportion betweene that atome and this unutterable weight: I ſee it is all quantitative; it is all finite; and all this exceſſe vaniſheth to nothing, and becommeth inviſible (like twinkling ſtarres, at the riſing of the much brighter ſunne) as ſoone as the loweſt and the meaneſt ſubſtance ſhineth out of that orbe, where they reſide that ſcorne diviſibility, and are out of the reach of quantity and matter. How vehement then muſt the activity and energy be, wherewith ſo puiſſant a ſubſtance ſhooteth it ſelfe to its deſired object? and when it enjoyeth it, how violent muſt the extaſie and tranſport be, wherewith it is delighted? How is it poſſible then for my narrow hart, to frame an apprehenſion of the infinite exceſſe of thy pleaſure (my ſoule) over all the pleaſure this limited world can afford, which is all meaſured by ſuch petty proportions? How ſhould I ſtampe a figure of thy immenſe greatneſſe, into my materiall imagination? Here I

looſe my power of ſpeaking, becauſe I have too much to ſpeake of: I muſt become ſilent and dumbe, becauſe all the words and language I can uſe, expreſſe not the thouſandeth, nor the millioneth part, of what I evidently ſee to be true. All I can ſay is, that whatſoever I thinke or imagine, it is not that: and that it is not like any of thoſe things; unto ſome of which unleſſe it be like, it is impoſſible for me to make any proportion or ſimilitude unto it. What then ſhall I doe, but lay my ſelfe downe in mine owne ſhadow, and there rejoyce that thou art a light ſo great, as I am not able to endure the dazeling ſpendour of thy rayes: that thy pleaſure is ſo exceſſive, as no part of it can enter into my circumſcribed heart, without dilating it ſo wide, that it muſt breake in ſunder: and that thy happineſſe is ſo infinite, as the higheſt pitch I can hope for to glut my ſelfe withall, during this darke night of my tedious pilgrimage here on earth, is to ſee evidently, that it is impoſſible for me in this life, to frame any ſcantling of it; much leſſe, to know how great it is. Shall I then once againe preſume to breake out into impatience, at my delay of ſo great bliſſe, and cry out that I am content with the meaneſt ſhare of this exuberant felicity? I care not for the exaggerations which a longer life may heape up unto it. I am ſure here is ſufficient to ſwell my heart beyond it ſelfe, to ſatisfie my thirſty ſoule, to diſſolve and melt all my powers, and to transforme me totally into a ſelfe bleſſed creature. Away, away all tedious hopes, not only of this life, but even of all increaſe in the next. I will leape boldly into that fountaine of bliſſe, and caſt my ſelfe headlong into that ſea of felicity; where I can neither apprehend ſhallow waters, nor feare I ſhall be ſo little immerſed and drowned, as to meete with any ſhelfe or dry ground, to moderate and ſtint my happineſſe. A ſelfe activity, and unbounded extent, and eſſence free from time and place, aſſure me ſufficiently, that I neede deſire no more. Which way ſoever I looke, I looſe my ſight, in ſeeing an infinity round about me. Length without points: Breadth without Lines: Depth without any ſurface. All content, all pleaſure, all reſtleſſe reſt, all an unquietneſſe and tranſport of delight, all an extaſie of fruition.

Happie forgetfulneſſe, how deepely am I obliged to thee, for making roome for this ſoule raviſhing contemplation, by removing this whiles all other images of things farre from me? I would to God thou mighteſt endure, whiles I endure; that ſo I might bee drowned

drowned in this preſent thought, and never wake againe, but into the enjoying, and accompletion of my preſent enflamed deſires. But alas, that may not be. The eternall light whom my ſoule and I have choſen for Arbiter, to determine unto us what is moſt expedient for us, will not permit it. We muſt returne; and that into feares and miſeries: For as a good life breedeth encreaſe of happineſſe, ſo doth an evill one, heape up Iliads of woe. Firſt (my ſoule) before I venture, we ſhould be certaine, that thy parting from this life, waft thee over to aſſured happineſſe: For thou well knoweſt, that there are noxious actions, which deprave and infect the ſoule, whiles it is forging and moulding here its body, and tempering for its future being: and if thou ſhouldeſt ſally hence in ſuch a perverſe diſpoſition, unhappineſſe would betide thee in ſtead of thy preſumed bliſſe. I ſee ſome men ſo ravenous after thoſe pleaſures, which cannot bee enjoyed out of the body, that if thoſe impotent deſires accompany their ſoules into eternity, I cannot doubt of their enduring an eternity of miſery: I cannot doubt of their being tormented with ſuch a dire extreamity, of unſatisfiable deſire and violent greife, as were able to teare all this world into pieces, were it converted into one heart; and to rive in ſunder, any thing leſſe then the neceſſity of contradiction. How high the bliſſe of a well governed ſoule is above all power of quantitie, ſo extreme muſt the ravenous inclemency, and vulturelike cruelty, bee of ſuch an uncompaſſable deſire gnawing eternally upon the ſoule; for the ſame reaſon holdeth in both: and which way ſoever the gravitation and deſires of a ſeparated ſoule doe carry it, it is hurried on with a like impetuouſity and unlimited activity. Let me then caſt an heedfull and warie eye, upon the actions of the generality of mankind, from whence I may gueſſe at the weale or woe, of their future ſtate: and if I finde that the greateſt number weigheth downe in the ſcale of miſery, have I not reaſon to feare leaſt my lot ſhould prove among theirs? For the greateſt part ſweepeth along with it every particular, that hath not ſome particular reaſon to exempt it from the generall law. In ſtead then of a few that wiſely ſettle their hearts on legitimate deſires, what multitudes of wretched men doe I ſee; ſome hungry after fleſh and blood; others gaping after the empty winde of honour and vanity; others breathing nothing but ambitious thoughts; others graſping all, and groveling upon heapes of melted earth? So that they put me all in a horrour, and make me feare, leaſt very few

they be, that are exempted from the dreadfull fate of this incomprehenſible miſery, to which I ſee, and grieve to ſee, the whole face of mankind deſperately turned. May it not then be my ſad chance, to be one of their unhappy number? Be content then, fond man, to live. Live yet, till thou haſt firſt ſecured the paſſage which thou art but once to venture on. Be ſure before thou throweſt thy ſelfe into it, to put thy ſoule into the ſcales: ballance all thy thoughts; examine all thy inclinations; put thy ſelfe to the teſt, try what droſſe, what pure gold is in thy ſelfe: and what thou findeſt wanting, be ſure to ſupply, before nature calleth thee to thy dreadfull account. It is ſoone done, if thou beeſt what thy nature dictateth thee to be. Follow but evident reaſon and knowledge, and thy wants are ſupplyed, thy accounts are made up. The ſame ever-ſhining truth, which maketh thee ſee that two and two are foure, will ſhew thee without any contradiction, how all theſe baſe allurements are vaine & idle; & that there is no compariſon between the higheſt of them, and the meaneſt of what thou mayeſt hope for, haſt thou but ſtrength to ſettle thy heart by the ſteerage of this moſt evident ſcience; in this very moment, thou mayeſt be ſecure. But the hazard is great, in miſſing to examine thy ſelfe truely and throughly. And if thou miſcarry there, thou art loſt for ever. Apply therefore all thy care, all thy induſtry to that. Let that be thy continuall ſtudy, and thy perpetuall entertainment. Thinke nothing elſe worth the knowing, nothing elſe worth the doing, but ſcrewing up thy ſoule unto this height, but directing it by this levell, by this rule. Then feare not, nor admit the leaſt doubt of thy being happy, when thy time ſhall come; and that time ſhall have no more power over thee. In the meane ſeaſon, ſpare no paines, forbeare no diligence, employ all exactneſſe, burne in ſummer, freeze in winter, watch by night, and labour by day, joyne monethes to monethes, entayle yeares upon yeares. Thinke nothing ſufficient to prevent ſo maine a hazard; and deeme nothing long or tedious in this life, to purchaſe ſo happy an eternity. The firſt diſcoverers of the Indies, caſt themſelves among ſwarmes of maneters; they fought and ſtrugled with unknowne waves; ſo horrid ones, that often times they perſwade themſelves they climbed up mountaines of waters, and ſtraight againe were precipitated headlong downe betweene the cloven ſea, upon the foaming ſand, from whence they could not hope for a reſource: hunger was their foode; ſnakes and

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ſerpents were their dainties; ſword and fire were their daily exerciſe: and all this, only to be maſters of a little gold, which after a ſhort poſſeſſion was to quitt them for ever. Our ſearchers after the Northerne paſſage, have cut their way through mountaines of yce, more affrightfull and horrible, then the Sympleyades. They have impriſoned themſelves in halfe yeare nights; they have chayned themſelves in perpetuall ſtone-cleaving colds: ſome have beene found cloſely imbracing one another, to concerve as long as they were able, a litle fewell in their freezing hearts, at length petrifyed by the hardneſſe of their unmercifulneſſe of that unmercifull winter: others have beene made the prey of unhumaine men, more ſavage then the wildeſt beaſts: others have beene never found nor heard of, ſo that ſurely they have prooved the foode of ugly monſters of that vaſt ycy ſea: and theſe have beene able and underſtanding men. What motives, what hopes had theſe daring men? What gaines could they promiſe themſelves, to countervaile their deſperate attempts? They aimed not ſo much as at the purchaſe of any treaſure for themſelves, but meerely to ſecond the deſires of thoſe that ſet them on worke; or to fill the mouthes of others, from whence ſome few crummes might fall to them. What is required at thy hands (my ſoule) like this? And yet the hazard thou art to avoide, and the wealth thou art to attaine unto, incomparably overſetteth all that they could hope for. Live then and bee glad of long and numerous yeares; that like ripe fruit, thou mayeſt drop ſecurely into that paſſage, which duely entred into, ſhall deliver thee into an eternity of bliſſe, and of unperiſhable happineſſe.

And yet (my ſoule) be thou not too ſoare agaſt, with the apprehenſion of the dreadfull hazard thou art in. Let not a tormenting feare of the dangers that ſurrounded thee, make thy whole life here bitter and uncomfortable to thee. Let the ſerious and due conſideration of them, arme thee with caution and wiſedome, to prevent miſcarriage by them. But to looke upon them with horrour and affrightedneſſe, would freeſe thy ſpirits, and benumme thy actions, and peradventure engulfe thee through puſillanimity in as great miſcheifes, as thou ſeekeſt to avoid. Tis true, the harme which would accrue from miſgoverning thy paſſage out of this life, is unſpeakable, is unimaginable. But why ſhouldeſt thou take ſo deepe thoughts of the hazard thou runneſt therein, as though the difficulty of avoiding it were ſo extreme, as might amount to an impoſſibility.

I allow, the thoughts that arme thee with wiſe caution to ſecure thy ſelfe, cannot be too deepe nor too ſerious; but when thou haſt providently ſtored thy ſelfe with ſuch, call thy ſpirits manfully about thee: and to encourage thee to fight confidently, or rather to ſecure thee of victory, ſo thou wilt not forſake thy ſelfe, turne thine eyes round about thee, and conſider how wiſe nature, that hath preſcribed an end and period unto all her plants, hath furniſhed them all with due and orderly meanes to attaine thereunto: and though particulars ſometimes miſcarry in their journey (ſince contingence is entayled to all created things) yet in the generality, and for the moſt part, they all arrive unto the ſcope ſhe levelleth them at. Why then ſhould we imagine, that ſo judicious and farre looking an Architect, whom we ſee ſo accurate in his meaner workes, ſhould have framed this maſterpiece of the world, to periſh by the way, and never to attaine unto that great end, for which he made it; even after he is prepared and armed with all advantagious circumſtances agreeable to his nature. That artificer, we know, deſerveth the ſtile of ſilly, who frameth ſuch tooles, as faile in their performance, when they are applyed to the action for which they were intended. We ſee all ſorts of trees for the moſt part beare their fruite in due ſeaſon; which is the end they are deſigned unto, and the laſt and higheſt emolument they are made to afford us. Few beaſts we ſee there are, but contribute to our ſervice what we looke for at their hands. The ſwine affordeth good fleſh, the ſheepe good wooll, the cow good milke, the ſable warme and ſoft furre, the oxe bendeth his ſturdy necke to the yoake, the ſpiritfull horſe dutifully beareth the ſouldier, and the ſinewy mule and ſtronger camell convey weighty marchandiſe. Why then ſhall even the better ſort of mankind, the chiefe, the top, the head, of all the workes of nature, bee apprehended to miſcarry from his end in ſo vaſt a proportion, as that it ſhould be deemed in a manner impoſſible, even for thoſe few (for ſo they are in reſpect of the other numerous multitude of the worſer ſort) to attaine unto that felicity which is naturall unto them? Thou (my ſoule) art the forme, and that ſupreme part of me, which giveth being both to me & to my body: who then can doubt, but that all the reſt of me, is framed fitting and ſerviceable for thee? For what reaſon were there, that thou ſhouldeſt be implanted in a ſoyle, which cannot beare thy fruite? The forme of a hogge, I ſee, is engrafted in a body fitt and appropriated for a ſwines operations:

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the forme of a horſe, of a lyon, of a wolſe, all of them have their organs proportioned to the maſtering piece within them, their ſoule. And is it credible, that only man, ſhould have his inferiour parts raiſed ſo highly in rebellion againſt his ſoule, the greateſt Miſtreſſe (beyond proportion) among all formes, as that it ſhall be impoſſible for her to ſuppreſſe their mutinies, though ſhe guide her ſelfe never ſo exactly by the preſcripts of that rule, which is borne with her? Can it be ſuſpected, that his forme, which is infinitely mounted about the power of matter, ſhould through the very neceſſity and principles of its owne nature, be more liable to contingency, then thoſe that are engulfed and drowned in it; ſince we know, that contingency, defectibility, and change, are the lame children of groſſe and miſshapen matter.

Alas it is too true, that nature is in us unhappily wreſted from her originall & due courſe. We find by ſad experience, that although her depravation bee not ſo totall, as to blind entirely the eye of Reaſon ſhe ſeeth by, yet it is ſo great, as to carry vehemently our affections quite croſſe to what ſhe propoſeth us as beſt. Howſoever let the incentives of fleſh and blood bee never ſo violent, to tumble humane nature downe the hill, yet if a contrary force, more efficatious then they with all their turbulent and miſty ſteames, doe impell it another way, it muſt needes obey that ſtronger power. Let us then examine whoſe motives, the ſoules, or the ſenſes, in their owne nature, worke moſt efficatiouſly in man. We are ſure, that what pleaſure he receiveth, he receiveth by meanes of his ſoule; even all corporall pleaſure: for, bee the working object never ſo agreeable and pleaſing unto him, he reapeth thence ſmall delight, if in the meane time, his ſoules attention bee carried another way from it. Certainely then, thoſe things muſt affect the ſoule moſt powerfully, which are conaturall unto her, and which ſhe ſeiſeth upon and reliſheth immediately; rather then thoſe impure ones, which come ſofiſticated to her, through the muddy channels of the ſenſes. And accordingly, all experience teacheth us, that her pleaſures, when they are fully favored, are much ſtronger then the pleaſures of our ſenſes. Obſerve but the different comportements of an ambitious, and of a ſenſuall man: and you will evidently perceive farre ſtronger motions, and more vehement ſtraines in the former, who hath his deſires bent to the ſatisfaction of his minde; then in the other, who aimeth but at the pleaſures of his body. Let us

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looke upon the common face of mankinde; and we ſhall ſee the moſt illuſtrious and noble part, taken with learning, with power, with honour; and the other part, which maketh ſenſe their idole, moveth in a lower and baſer orbe under the others; and is in a ſervile degree to them. Since then humane nature is of it ſelfe more inclined to the contentments of the active minde, then of the dull ſenſe; who can doubt but that the way of thoſe pure contentments, muſt bee farre ſweeter then the groſſe and troubled ſtreames of ſenſuall pleaſures: which if it bee, certainely man in his owne nature, is more apt to follow that: and when hee chanceth to wander out of that ſmooth and eaſie roade, his ſteps are painefull and wearifome ones: and if he doe not preſently perceive them ſuch, it is, becauſe it fareth with him, as with thoſe that walke in their ſleepe, and ſtray into rough and ſtony paſſages, or among thiſtles and bryers; whiles peradventure ſome illuding dreame bewitcheth their fanſies, and perſwadeth them they are in ſome pleaſant garden; till waking, (if at leaſt they wake before they fall into a deadly precipice) they finde their feete all gored, and their bodies all ſcratched and torne. If any ſenſuall man ſhould doubt of this great truth, and find it hard to perſwade himſelfe, that intellectuall pleaſures (which to his depraved taſte, ſeeme cold and flat ones) ſhould bee more active and intenſe, then thoſe feculent ones, which ſo violently tranſport him; let him but exerciſe himſelfe a while in thoſe entertainements which delight the mind, taking leave during that ſpace, of thoſe unruly ones, which agitate the body; and continue doing thus, till by long practiſe, hee hath made them eaſie and habitated himſelfe unto them: and I will engage my word, that hee will finde this change ſo advantageous to him, even in contentment and delight, that he will not eaſily be brought backe to his former courſe of life. Experience ſheweth us, that whatſoever is long cuſtomary to us, turneth into our nature; ſo much, that even diſeaſes and poyſons by diuturne uſe, doe mould and temper to themſelves thoſe bodies, which are habituated to them; in ſuch ſort, that thoſe peſtes of nature muſt be kept on foote, and fed upon for our ſubſtance. How much more then muſt the moſt connaturall exerciſe of mentall pleaſure, turne ſo ſubſtantially in our being, that after ſome good practiſe in it, we ſhall not be able, without great ſtruggling and reluctation, to live without it.

The violence of fruition in thoſe foule puddles of fleſh and blood, preſently

preſently glutteth with ſatiety, and is attended with annoy and with diſlike: and the often uſing and repeating it, weareth away that edge of pleaſure, which only maketh it ſweete and valuable, even to them that ſet their hearts upon it; and nothing heighteneth it, but an irritation by a convenient hunger and abſtinence. Contrarywiſe, in the ſoule, the great and more violent the pleaſure is, the more intenſe and vehement the fruition is; and the oftner it is repeated, ſo much the greater appetite and deſire we have, to returne unto the ſame; and nothing provoketh us more, then the entire and abſolute fruition of it. If a ſuddaine change from one extreame of fleſh and blood, to the other oppoſite pole of ſpirituall delights and entertainements, ſeeme harſh to him, whoſe thoughts by long aſſuefaction, are glewed to coporall objects; let him beginne with gently bridling in his inferiour motions under a faire rule of governement: If hee cannot preſently ſuppreſſe and totally mortifie their clamorous deſires, let him at the leaſt moderate and ſteere them according to the bent of reaſon. If wee will but follow this courſe which nature teacheth us, to heighten even our ſenſuall delights and pleaſures, by reaſonable moderation of them to their owne advantage; we ſhall finde her ſo kinde a mother to us, that of her ſelfe ſhe will at length quell and diſincumber us of all our enemies. If we but temperately attend her worke, ſhe will quietly waft us over to our deſired end, to our beloved happineſſe. In a few yeares, by boyling away our unruly heate, ſhee will abate, and in the end quite weare away the ſenſe of thoſe tranſporting pleaſures, wee uſed to take ſo much delight in the fruition of. With in a while, rheumes will ſo clogge our tongue and palates, that wee ſhall but flatly reliſh the moſt poinant meates. Our dulled eares will no longer devoure with delight, the raviſhing ſound of ſweete harmonies. Our dimme eyes will carry to our heavie fanſie but confuſed newes of any beautifull and pleaſing objects. Our ſtopped noſethriles will afford no paſſage for ſpiritfull perfumes, to warme and recreate our moyſt and drowſie braine. In a word, nature will ere long, warne us to take a long farewell of all thoſe contentments and delights, which require a ſtrong, vigorous, and athletike habite of body to enjoy. She will ſhew us, by ſetting our graves before our eyes, how vaine this glittering fanſie of honour is: how unprofitable the ſtaffe of power to underproppe our falling being; how more burthenſome then helpefull are thoſe maſſie heapes of gold and ſil-

ver, which when we have, the greateſt uſe we make of them, is but to looke upon them, and court them with our dazeled eyes; whiles they encompaſſe us with armies of traytours & of hungry wolves, to teare them from us, and us in pieces for their ſake. Thus will nature of her ſelfe in a ſhort time, dull thoſe weapons that offend us, and deſtroy the enemies of thoſe verities that ſhine upon us. Courage then, my ſoule, and neither feare to live, nor yet deſire to die. If thou continueſt in thy body, it is eaſie for thee, and ſweete and contentſome, to heape up treaſures for eternity. And if thou parteſt from it, thy hopes are great and faire, that the journey thou art going, is to a world of unknowne felicitie. Take heart then, and march on then with a ſecure diligence, and expect the hand of bounteous nature, to diſpoſe of thee, according as ſhee hath wiſely and benignely provided for thee. And feare not but that if thou haſt kept a reaſonable amity with her, ſhe will paſſe thee to where thou ſhalt never more bee in danger of jarring with her; nor of feeling within thy ſelfe the unkind blowes of contrary powers fighting in thee, whiles thou bleedeſt with the woundes that each ſide giveth; nor of changing thy once gained happineſſe into a contrary condition, according to the viciſſitudes of all humane affaires. But ſhalt *For ever*, bee ſwelled to the utmoſt extent of thy infinite nature, with this torrent, with this abiſſe of joy, pleaſure, and delight.

But here (my ſoule) well mayeſt thou ſtand amazed at this great word *For ever*. What will this be, when fleeting time ſhall be converted into permanent eternity? ſharpen thy ſight to looke into this vaſt profundity. Suppoſe that halfe an houre, were reſumed into one inſtant or indiviſible of time: what a ſtrange kinde of durance would that be? I ſee that halfe an houre, is diviſible without end, into halfes, and halfes of halfes, and quarters of quarters; and after myriades of diviſions, no parcell is ſo little, but that it hath an infinite ſuperproportion to an indiviſible inſtant. What a prodigious thing then muſt it be, to have an inſtant equaliſe halfe an houre? were it but ſome ordinary notion or quiddity, as of magnitude, of place, of activity, or the like, in which this excellency of an indiviſibles equaliſing a large extent, were conſidered; my fantaſie would offer to wreſtle with it; and peradventure, by ſtrong abſtraction, and by deepe retyrement into the cloſet of judgement, I might hazard to frame ſome likeneſſe of it. But that wherein this multiplycation

is,

is, is the noblest, the highest, and the roote of all other notions, it is *Being* and *Existence* it selfe. I my selfe, whiles I am, have my existence determined but to one poore instant of time; and beyond that, I am assured of nothing. My slender thridde of *Being* may breake I still find that it may breake a sunder, as neere to that instant, as I can suppose any thing to be neere unto it: and when I shall have supposed, *Here* it may breake neerer and neerer; and that I can never arrive to settle the neerest point where it may snap in two. But when time shal be no more; or at the least shall in respect of me, be turned into Eternity; then this fraile Existence of mine, will be stretched out beyond the extent of all conquering time. What strange thing then, is this admirable multiplycation of existence? or how may I bee able to comprehend it? Existence is that which comprehendeth all things: and if God be not comprehended in it, thereby it is, that he is incomprehensible of us: and he is not comprehended in it, because himselfe is it. He is Existence: and by being so, hee equaleth, not comprehendeth it. From hence then I may gather the excellency and vast empire of existence, in its owne nature: and so conclude how admirable a change and betterment that must bee, which encreaseth, and multiplyeth so infinitely the existance I now enjoy; for be it never so specious; be it never so glorious; be it what it is, existence, the top, the flower, the perfection of all created things; still there is a flaw, there is a defect, a shortnesse, a limitation in it: for now, my soule, thou art but a part of me; and dost exist in such a manner by succession, that the security and possession of it, is of lesse then of any thing whatsoever in the world; for it is of nothing more, then of an indivisible; which being such, in truth is nothing. But when the walls shall be broken downe, that here confine thee to such a nothing of existence, (which yet is infinitely more noble, then all other degrees of notions) then thou shalt summe up time in formall *being*, and not be limited, as now thou art, to this so divided a succession. Thou shalt bee an houre without divisibility: and if an houre, a yeare: if so, an age: an if and age, then for ever, for all eternity.

But whither art thou flowne, my soule? to what a dazeling height art thou mounted? Thou art now soared to such a lessening pitch, as my faint eyes are no longer able to follow thy touring flight: my head groweth giddy, with gazing up; whiles thou lookest downe, to see time runne an infinite distance beneath thee;

wasting the existences of all corporall things from nothing to nothing, in a perpetuall streame: and thou secure, and out of the reach of its venimous and all destroying truth. Let me call to minde, all the violent pleasures of my heady youth: let mee summe up their extent according to those deceitfull measures I then rated happinesse by: let me in my fancy chew over againe the excessive good, I then fondly imagined in them: and to all this, let mee adde as much more joy and felicity, as in my weake thoughts, I am able to faddome or but aime at: and then let me say (and with rigorous truth I shall say it) all this excesse of blisse, will be resumed, will be enjoyed to the full, in one indivisible moment: let mee thinke with my selfe, if then, when pleasure was the Idoll I sacrificed all my thoughts unto, I might in one quarter of an houre have enjoyed a pleasure, or at the least, have hoped for one, that should have equalised at once all those, that in my life I ever tasted: what would not I have beene content to give in purchase of that single quarter of an houre? and in stead of this pleasant dreame, I now see that one reall moment, will truly and solidely give to thee and me, the quintessence, the Elixir of content and happinesse; not drawne out of such 40 yeares, as I have struggled through the world in various fortunes; but out of ages and ages of pleasure, greater farre then can be conceived by a heart of flesh; and multiplyed beyond the Arithmeticke of intelligences. And this happie moment, shall not be of their soddaine fleeting and expiring nature, that are assigned to time; but shall endure beyond the extent of that time, which surpasseth al multiplication. I see plainly that I must multiply eternity, by eternity, to frame a scantling of that blisse, which a wel passed life in this world, shall bring me to in the next. And yet it will be as farre short, and as much beneath the selfe-blessednesse of him that giveth one this, as nothing is short of all that is. For my blisse shall have a beginning; and though it never shall have end, yet that belongeth not to it for its owne sake, but proceedeth meerely from the bounteous hand of the nothing annihilating selfe essence: from whom there is no more feare of the fayling of his liberall superfluence of *Being* upon me, then there is of his own deficiency from being selfe *Being*. But how can these things stand together? That indivisibly I shall possesse a tenure beyond all possible time? and nevertheless *possibly*, notwithstanding my possession, I may bee bereft of what I enjoy? who can reade this riddle? who can dive into

into this abiſſe? who can ſhoote light into this infinite pitte of dark eneſſe? It is the abundance and exceſſe of light that here ſtriketh us blinde. Who can ſtrengthen our eyes to endure eaglewiſe this glorious and reſplendent ſunne? Nothing ſure in this world; unleſſe it be ſilence and ſolitude. To theſe therefore let us conſecrate the reverend contemplation of this awefull myſtery; which is but profaned, if it be expoſed to vulgar eyes: and to ſuch night-owles and battes as we are, whiles the troubled fantſies of reeking ſenſe and worldly occupations, do overcloud of my ary thoughts.

Now then if nature by ſhort and thicke ſtepps at the beginning, and by larger paces in the progreſſe, hath delivered us over into a night of pure light, where we can ſee nothing, becauſe every thing is too viſible; ſo that we are faine to vaile our eyes, and are conſtrained to retyre our ſelves to medicate and arme them, before wee expoſe them to ſo ſtrong and glorious beames: how ſhould wee dare to looke upon thoſe admirable heights (infinitely ſurpaſſing all theſe) with which the overconquering Grace hath crowned and ſwelled up the extent of nature? What ſight is ſharpe enough to penetrate into the myſterious eſſence, ſprouting into different perſons? Who can looke upon the ſelfe multiplyed unity, upon the incomprehenſible circumince ſſion, upon thoſe wondrous proceſſions, and idiomes reſerved for Angels eyes?

Of theſe, (my ſoule) whoſe ſhootings reach infinitely higher beyond all that we have ſaid, then what we have ſaid is beyond the dull and muddy motions of this life; thou art not capeable now of receiving any inſtructions: let firſt the myſtagogicall illuminations of the great Areopagite; and the Aſcetike diſcipline of the Anachoreticall inhabitants of the wilderneſſe, purifie the eye, before thou attempteſt to ſpeake, or to aime at the diſcovery of theſe abiſming depths. By them thou muſt be firſt irrigated with the ſweet ſhoures of mornings and evenings, with the gentle deawes, and mannadropps, which fall abundantly from thoſe bounteous favours that reſide in a higher ſphere then nature; and that poure out, unknowne and unconceiveable bleſſings upon prepared hearts: which fructifie into that true bliſſe, in compariſon whereof, all that we have hitherto declared, is but ſhaddow, vanity, and nothing.

*FINIS.*

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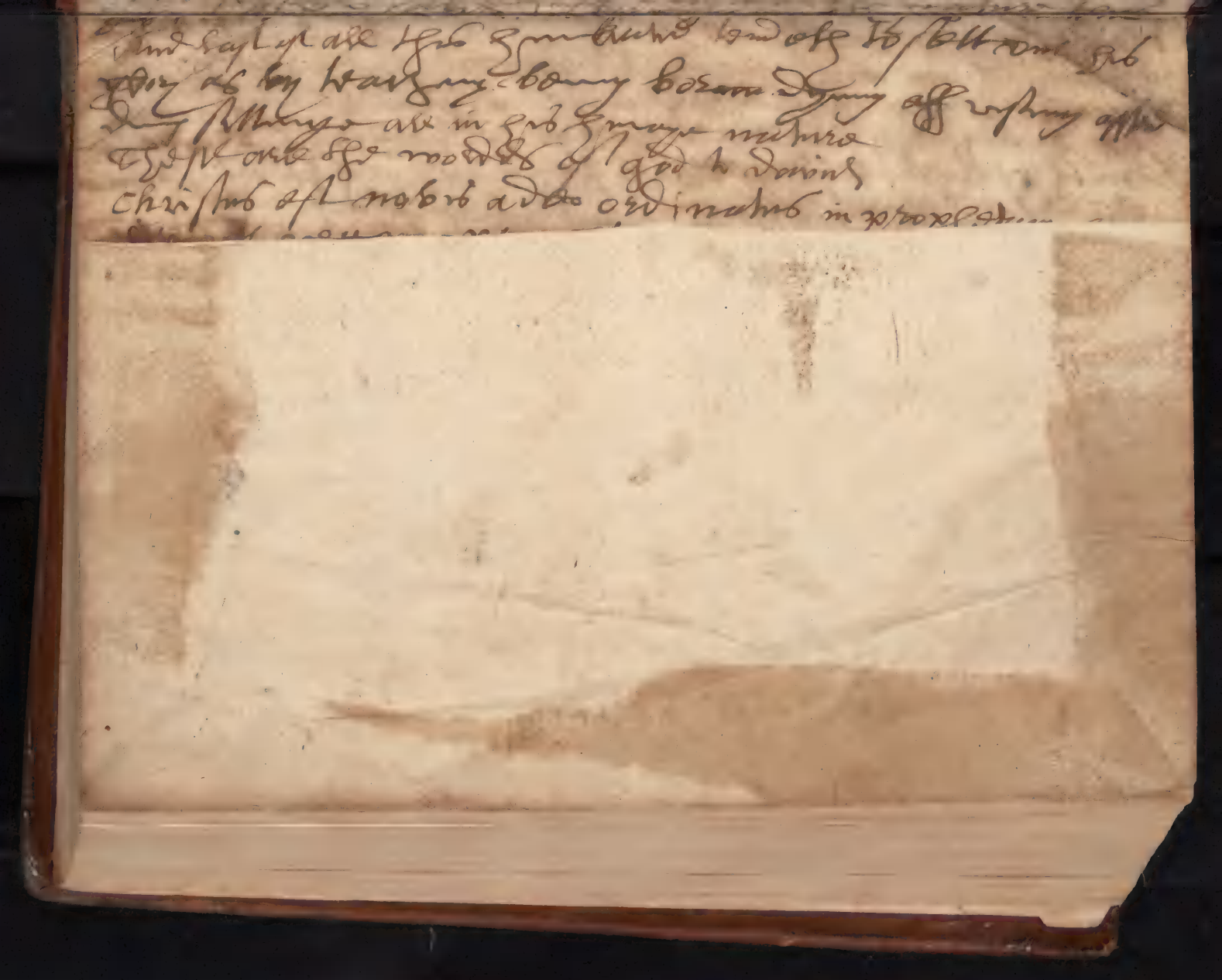
# PRIVILEGE DV ROY.

LOVYS PAR LA GRACE DE DIEV ROY DE FRANCE ET DE NAVARRE, A nos amez & feaux les gens tenans nos Cours de Parlemens, Baillifs, Seneſchaux, Prevoſts, leurs Lieutenans, & tous autres nos Juſticiers & Officiers qu'il appartiendra, Salut, *Le Sieur Kenelme Digby Cheualier Anglois, nous a fait remonſtrer qu'il a compoſé un Liure en langue Angloiſe, contenant deux Traitez, l'un de la nature du corps, & l'autre de la nature des ames, auec une recherche de l'immortalité de celles qui ſont raiſonnables.* Lequel il deſireroit mettre en lumiere & faire imprimer, s'il avoit nos lettres à ce neceſſaires: leſquel les nous faiſant ſupplier luy vouloir octroyer. A ces cauſes luy avons permis & accordé, permettons & accordons par ces preſentes faire imprimer & debiter ledit Liure pendant ſix ans. Durant leſquels nous faiſons deffenſes à tous Libraires & Imprimeurs de noſtredit Royaume, de l'imprimer vendre, ny debiter, ſoit ſous quelque marque de déguiſement ou traduction que ce ſoit, ſans le conſentement dudit ſieur Digby, à peine de trois mille liures d'amende, confiſcation des exemplaires qui s'en trouueront, & de tous deſpens dommages & intereſts envers luy. Si vous mandons & à chacun de vous enjoignons tenir la main à l'execution des preſentes, leſquelles voulons eſtre tenuës pour deuëment ſignifiées, en mettant copie d'icelles au commencement ou à la fin de chacun deſdits Liures. A la charge de mettre par ledit ſieur Digby une exemplaire dudit Liure en noſtre Biblioteque, & une autre en celle de nullité deſdites preſentes. Car tel eſt noſtre plaiſir, nonobſtant oppoſitions ou appellations quelconques, clameur de Haro, chartre Normande, & lettres à ce contraires. Donné à Fontainebleau le vingt-ſixieſme jour de Septembre, l'an de grace mil ſix cens quarantequatre, & de noſtre Regne le deuxieſme.

*Par le Roy en ſon Conſeil,*

GVITONNEAV.



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